# CONTRIBUTIONS FROM THE UNIVERSITY OF MICHIGAN HERBARIUM

VOLUME 20

UNIVERSITY OF MICHIGAN HERBARIUM
ANN ARBOR, MICHIGAN
19 JUNE 1995

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19 June 1995

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# RUP CHAND 1902–1994

Rup Chand was born on April 16, 1902, in the Lahul district of the Punjab in India. He was the son of Thakur Jai Chand and Thakur Kalzang Dolma. The Thakur family was well known in Lahul, as one of their ancestors had been given the status of chief of Ko-lon and this position had passed on to the eldest son for many generations.

During the summer of 1930, a fortuitous meeting occurred on a mountain pass near Rup Chand's valley. Walter Koelz (a scholar from the University of Michigan working as a research scientist for the Roerichs, Russian expatriates based in Kulu) was sitting in the cool shade of a cave when Rup Chand happened by. At Dr. Koelz's request, Rup Chand visited the Roerich encampment. Because he knew the country well, Rup Chand was offered, through an interpreter, the opportunity to join forces with Dr. Koelz in the pursuit of both plant and bird collections. Rup Chand decided to accept the offer, and the two worked and traveled together for nearly thirty years.

Rup Chand's earliest plant specimen collected under his own name appears in the University of Michigan Herbarium collection under the date of May 11, 1932. He amassed more than 8000 collections from Assam, India, Persia, Nepal, Tibet, and Afghanistan during years devoted to field work.

Rup Chand came to the United States with Dr. Koelz in 1934 and again in 1937. The photograph shown above on the left was taken during the 1934 visit. Here in Michigan, he met Professor Harley Bartlett, Chair of the Botany Department and Director of the University's Botanical Gardens. Professor Bartlett extended a series of University appointments to help support Rup Chand's plant

collecting, and when Dr. Koelz returned to Michigan in October of 1953, Professor Bartlett actively pursued and was crucial to finally securing permission for Rup Chand to immigrate to this country in 1956.

Until 1960, Rup Chand worked independently on extensive labeling projects for the Koelz and Rup Chand collections. In 1960, in response to a serious backlog of unidentified, unmounted specimens of great value, the National Science Foundation awarded a grant to the University of Michigan Herbarium, which permitted Professor Rogers McVaugh, Curator of Vascular Plants, to offer support for Rup Chand to work in the Herbarium. Rup Chand became a full-time plant mounter on July 1, 1960. Dr. Ralph Stewart, a recognized authority on the flora of northern India and the Himalayas, had just retired from Gordon College in Rawalpindi and, at Professor McVaugh's invitation, accepted an appointment with the Herbarium beginning in September of 1960. He and Rup Chand worked together on these collections for many years.

Rup Chand retired officially from the University at the end of 1970, but continued on a part-time hourly basis to work for Professor McVaugh. As funds were available, he worked on translating his journals, kept while he was collecting plants, from Urdu into English. These now reside in the Herbarium library and provide a most interesting background to the collections.

Rup Chand was much beloved by the staff and faculty of the Herbarium. He returned the affection in many ways...as a friend, a story teller, a musician, and as a host for his annual pilau party, given when the flowering crabapples bloomed on Awixa Drive near his home in Ann Arbor. The right-hand photograph on page 1 was taken in home in December, 1993. He died on August 18, 1994. He will be missed by all of us, and as a token of our fondness for him, we dedicate Volume 20 of the *Contributions from the University of Michigan Herbarium* to Rup Chand.

———Carolyn Copeland

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# REVISION OF THRYALLIS (MALPIGHIACEAE)

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*Thryallis* comprises five species found in Brazil and adjacent Paraguay and Bolivia (Fig. 1). The genus is distinctive in its stellate pubescence covering nearly all parts, yellow flowers with eglandular sepals and petal limbs wider than long, and schizocarps of three nutlets subtended by a persistent spreading calyx. *Thryallis* is not similar to any other genus in the family, and its affinities are unknown; it is included in a current study by W. R. Anderson and M. C. Chase, who are investigating the phylogeny of the Malpighiaceae by comparing evidence from chloroplast DNA and morphology.

Although the genus differs greatly from other members of the Malpighiaceae, the species are morphologically similar and are best separated by characters of the abaxial leaf vesture and of the glands found at the base of the lamina and/or apex of the petiole (Fig. 2). The flowers are relatively uniform; only *T. parviflora* differs notably in its small petals and short styles. They are arranged opposite to subopposite on axes that are grouped into dichasia, compound dichasia, or small thyrses. Each short peduncle is subtended by a bract and bears a much longer pedicel, which is subtended by two bracteoles. The eglandular sepals are reflexed to revolute during anthesis, but as the fruit matures they elongate and become stiff and spreading. The three nutlets are then subtended by the rotate persistent calyx, which may aid in dispersal. The claw of the petal is ribbonlike, ca 1–1.5 mm wide, and expands into an oblate/reniform limb. The stamens differ only in that the anthers of those opposing the petals are slightly shorter than those opposing the sepals. The 3-carpellate ovary bears three slender styles; the capitate stigma is slightly reflexed and also slightly decurrent adaxially. Each rugose nutlet has the developing seed embedded in spongy tissue, presumably perisperm, that fills the locule, an unusual condition in the family. At maturity, the seed entirely replaces the spongy tissue.

The laminas are adaxially stellate-pubescent only when very young and soon become glabrous, whereas they are always abundantly pubescent abaxially. The unicellular hairs vary from subsessile to stalked. The stalk is up to 0.4 mm long, and from its apex radiate 5–13 (–15) branches up to 0.3 mm long. The abaxial lamina may also bear sessile hairs, the body ca 0.5 (–0.7) mm in diameter with 8–19 short branches up to 0.2 (–0.3) mm long. It is the mixture of sessile hairs and hairs with stalks of variable length that give the abaxial vesture its distinctive aspect. In *T. brachystachys* the sessile and short-stalked hairs (mostly only up to 0.01 mm long) are so densely packed that the vesture has a felty aspect and obscures the secondary and tertiary veins. In contrast, the pubescence of *T. latifolia* and *T. parviflora* is much looser; the stalks of the hairs vary from 0.03 to 0.4 mm long and are individually discernible. In all three species a basal cover of sessile hairs aids in hiding the epidermis. Such sessile hairs are absent in *T. longifolia*, in which the vesture is a mixture of long-stalked hairs (up to 0.3 mm long)

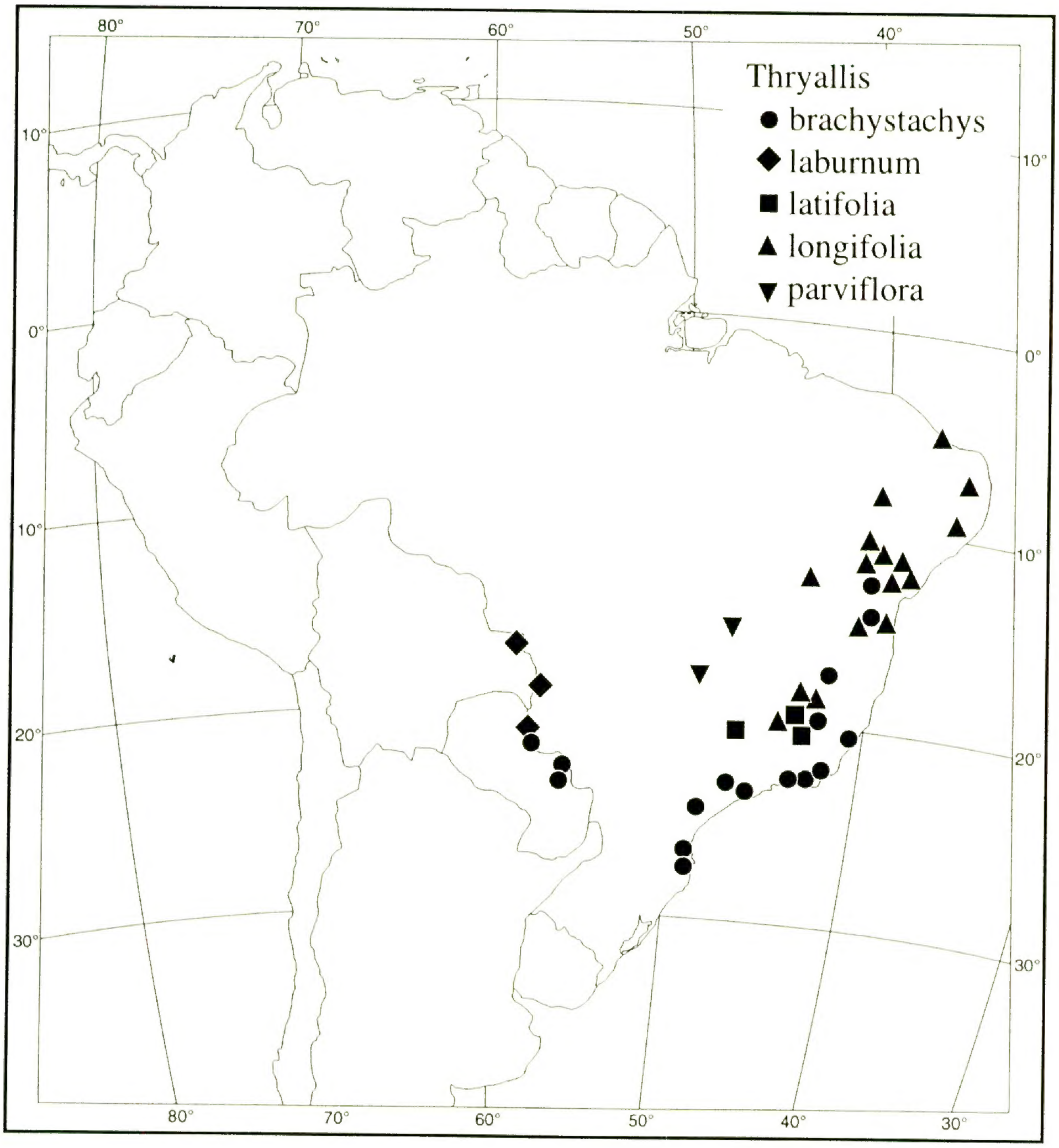


FIG. 1. Distribution of *Thryallis*.

with the branches radiating only from the apex and shorter, somewhat stouter hairs in which branches radiate from the body of the stalk as well. The epidermis is always visible, owing to the loose arrangement of the hairs and the absence of sessile hairs. In *T. laburnum* the sessile hairs are lost as the leaf matures, and the epidermis is generally visible among the stalked hairs in older leaves. Yet, in a few instances (e.g., the NY duplicate of *Moore 970*) the larger leaves of the flowering branches that constitute the specimens still have the sessile hairs and, since the stalked hairs are only up to 0.1 mm long, thus are reminiscent of the leaves of *T. brachystachys*.

A pair of glands occurs at the base of the lamina or at the apex of the petiole, or the glands are borne along the margin a short distance from the base. Occasionally the glands are branched, and there may also be a second smaller pair. The glands are generally nearly circular and prominent (mostly to 0.5 mm but sometimes to 1 mm long). In *T. longifolia* and *T. parviflora* the glands are commonly elongated and knob- or peglike, up to 5.5 mm long; these, too, may be branched (Fig. 2c, d, m).

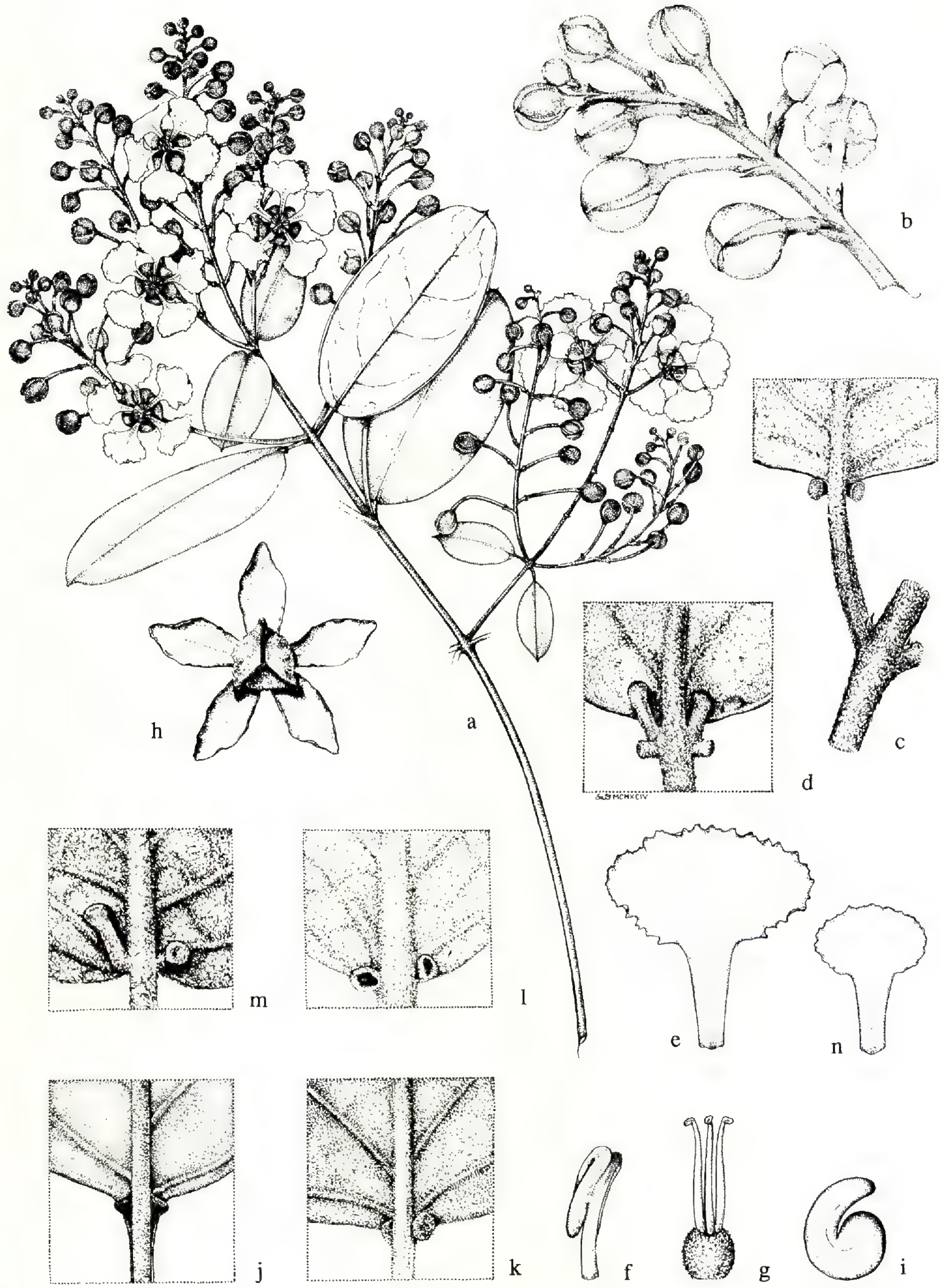


FIG. 2. *Thryallis*. a–i. *T. longifolia*. a. Flowering branch (×0.5). b. Apex of young inflorescence branch showing bracts and bracteoles (×4). c. Base of lamina, abaxial view, and petiole attachment, showing glands and epipetiolar stipules (×2.5). d. Base of lamina, abaxial view showing branched peglike glands at apex of petiole and sessile glands on margin of lamina (×2.5). e. Lateral petal (×2.5). f. Stamen (×5). g. Gynoecium (×5). h. Fruit with persistent calyx (×1.5). i. Embryo (×5). j. *T. brachystachys*, base of lamina, abaxial view showing glands (×2.5). k. *T. laburnum*, base of lamina, abaxial view showing glands (×2.5). l. *T. latifolia*, base of lamina, abaxial view showing glands (×2.5). m, n. *T. parviflora*. m. Base of lamina, abaxial view showing branched peglike glands (×2.5). n. Lateral petal (×2.5). (Based on: a–c, *Harley 16195*; d, *Harley 16429*; e–g, i, *Anderson 11379*; h, *Lützelburg 25770*; j, *Sucre 1442*; k, *Fróes 11690*; l, *Heringer 3815*; m, n, *Irwin 11341*.)

The confusion surrounding the generic name *Thryallis* was discussed by Morton and Cuatrecasas (1967), who proposed conservation of the name *Thryallis* Mart. Linnaeus (1762) first published the name *Thryallis* with the species *T. brasiliensis*. Lindley (1828) published his *T. brachystachys* from Rio de Janeiro and Martius (1829) his *T. longifolia* and *T. latifolia* from Bahia; Martius also included a generic description. Jussieu (1832), the first monographer of the Malpighiaceae, noted that Lindley's and Martius's species were not congeneric with that of Linnaeus. He assigned *T. brasiliensis* L. to the genus *Galphimia* Cav., as *G. brasiliensis* (L.) Adr. Juss. (1832), and recognized *Thryallis* sensu Mart., in which he included *T. longifolia*, *T. latifolia*, and *T. brachystachys* (1840). Kuntze (1891) retained *Thryallis* L. and proposed *Hemsleyna* to replace *Thryallis* sensu Mart. In this he was followed most notably by Small (1910), who included species of *Galphimia* in *Thryallis* L. Niedenzu (1914, 1928), the second monographer of the family, rejected Kuntze's *Hemsleyna* and followed Jussieu in accepting *Thryallis* Mart. The proposal by Morton and Cuatrecasas (1967) for conservation of *Thryallis* Mart. was accepted by the Nomenclature Section of the 11th International Botanical Congress in 1969, and *Thryallis* Mart. thus is included in the list of conserved names of the *International Code of Botanical Nomenclature* (Greuter et al. 1988). Regrettably, in some herbaria species of *Galphimia* are still routinely filed under *Thryallis*, perhaps in the mistaken belief that because *Thryallis* is a conserved name it displaces *Galphimia*. The correct disposition of names published in *Thryallis* that apply to species of *Galphimia* is beyond the scope of this revision; the reader is referred to Niedenzu's list of names excluded from *Thryallis* Mart. (1928, p. 577).

**Thryallis** Martius, Nov. gen. sp. 3: 77. 1829, nom. cons., non *Thryallis* L., nom. rej.—LECTOTYPE, designated by Morton and Cuatrecasas, 1967: *Thryallis longifolia* Martius.

*Hemsleyna* Kuntze, Rev. gen. pl. 1: 88. 1891.—LECTOTYPE, here designated: *Hemsleyna longifolia* (Martius) Kuntze [=*Thryallis longifolia* Martius].

Scandent shrubs to woody vines. Stems and branches densely stellate-pubescent, the larger vegetative axes becoming glabrate to glabrous in age. Laminas elliptical to lanceolate or broadly so to sometimes suborbicular, apex apiculate to acuminate or apiculate-emarginate or obtuse-apiculate, base truncate or slightly cordate, adaxially stellate-pubescent when very young but soon glabrous, abaxially abundantly stellate-pubescent, with 1–2 pairs of glands at the apex of the petiole and/or the base of the lamina; petioles densely stellate-pubescent; stipules narrowly triangular, epipetiolar. Flowers borne opposite to subopposite on axes grouped in dichasia or compound dichasia or small thyrses, sometimes with 4 axes at a node; each peduncle subtended by a bract, each pedicel subtended by 2 bracteoles, pedicels always longer than the peduncles, bracts and bracteoles deciduous during anthesis or some retained through the fruiting stage or all caducous; axes, peduncles, pedicels, bracts, and bracteoles densely stellate-pubescent. Sepals 5, imbricate, elliptical to broadly so to broadly ovate, eglandular, densely stellate-pubescent adaxially and abaxially but with a glabrous patch at the base adaxially, reflexed to revolute during anthesis, elongating and becoming stiff and spreading in fruit. Petals 5, bright lemon-yellow, glabrous, the claw ribbonlike, ca. 1–1.5 mm wide, the limb wider than long, oblate/reniform, margin irregularly dentate to erose or nearly lacerate, the lateral petals subequal or the anterior-lateral petals slightly larger than the posterior-lateral petals, the posterior petal with a thicker claw and

a little smaller than the lateral petals. Stamens 10, all fertile, glabrous, anthers abaxially with a gland on the connective, those of stamens opposing the petals slightly shorter than of those opposing the sepals. Gynoecium 3-carpellate (sometimes 2-carpellate); styles 3 (sometimes only 2), slender, glabrous, erect, stigma capitate but somewhat reflexed and briefly decurrent adaxially, posterior styles slightly shorter than the anterior one; ovary densely stellate-pubescent. Fruit a schizocarp of (2–) 3 tardily separating nutlets subtended by the persistent calyx; nutlets rugose, with a prominent dorsal ridge or a small winglet; developing seed embedded in spongy tissue (perisperm?) filling the locule, mature seed filling the locule and then spongy tissue absent; seed and embryo ovoid, the large outer cotyledon distally folded over the smaller inner cotyledon.

## Key to the Species of Thryallis

1. Abaxial vesture of all or at least the mature, larger leaves composed only of stalked hairs, sessile hairs absent and thus the epidermis readily visible.
   2. Limb of lateral petals 7–10 mm long, 11–14 mm wide; laminas with a pair of prominently raised to peglike glands at the apex of the petiole, each gland 0.5–3.5 mm long, 0.5–0.7 mm in diameter, sometimes branched, often also with a second prominent pair at the base of the lamina or along the margin near the base; abaxial vesture of leaves of hairs with the stalk 0.1–0.3 mm long, in longer hairs the branches radiating from the apex only, the shorter hairs commonly with a stouter stalk and the branches radiating from along the stalk as well, sessile hairs always absent; eastern Brazil (Ceará to Bahia, and eastern Minas Gerais). *T. longifolia.*
   2. Limb of lateral petals 6.5–8 mm long, (9–) 10–12 mm wide; laminas with a pair of prominently raised (never knob- or peglike) glands at the apex of the petiole, each gland 0.2–0.5 mm long, 0.7–1.2 mm in diameter; abaxial vesture of leaves of hairs with the stalks 0.01–0.1 mm long, the branches all radiating from the apex, in young leaves and in the reduced ones associated with the inflorescence sessile hairs present and thus obscuring the epidermis; southwestern Brazil (Mato Grosso do Sul) and adjacent Bolivia and Paraguay. *T. laburnum.*
1. Abaxial vesture of all leaves composed of short- to long-stalked hairs and sessile hairs, the epidermis not readily visible.
   3. Laminas not rugose, adaxially the costa impressed but the secondary veins only slightly so or not at all, abaxially the costa prominently raised, the secondary veins prominulous, and the tertiary veins indistinct and mostly hidden by the dense indumentum; abaxial vesture of laminas composed of a mixture of stalked hairs and sessile hairs, the stalks to 0.1 (–0.2) mm long, the vesture very dense and forming an even covering, the stalks of individual hairs barely discernible (vesture sometimes looser in specimens from Santa Catarina); Brazil (eastern Minas Gerais, Espirito Santo to Santa Catarina) and eastern Paraguay. *T. brachystachys.*
   3. Laminas rugose, the costa and all veins impressed adaxially, abaxially the costa, secondary, and tertiary veins prominently raised and the areoles sharply distinct; abaxial vesture of laminas composed of a mixture of short- to long-stalked hairs and sessile hairs, the stalks to 0.4 mm long, the vesture with a loose aspect, the stalks of individual hairs discernible.
      4. Limb of lateral petals 4–5.5 (–6) mm long, 6–8 mm wide; laminas with a pair of glands at the apex of the petiole or at the base of the lamina at insertion of petiole, each gland knoblike to commonly peglike, 1.4–5.5 mm long, 0.5–1.4 mm in diameter, sometimes branched and the two pairs unequal in size; stalked hairs of abaxial laminar pubescence with 5–8 radiating branches; bracts and bracteoles deciduous or persistent during anthesis and sometimes retained in fruit; Brazil (Distrito Federal and Goiás). *T. parviflora.*
      4. Limb of lateral petals 10–11 mm long, 13–14 mm wide; laminas with a prominently raised pair of glands (sometimes branched, rarely peglike) at the apex of the petiole, each gland 0.3–1 (–2) mm long, 0.7–1.2 mm in diameter, sometimes also with a second prominent pair at base of the lamina or along the margin near the base; stalked hairs of abaxial laminar pubescence with 6–13 radiating branches; bracts and bracteoles caducous or deciduous during anthesis, not retained in fruit; Brazil (Minas Gerais and adjacent São Paulo). *T. latifolia.*

**Thryallis brachystachys** Lindley, Bot. Reg. 14: 1162. 1828. *Hemsleyna brachystachys* (Lindley) Kuntze, Rev. gen. pl. 1: 88. 1891.—TYPE: [BRAZIL.] Specimen prepared from plants grown at the garden at Chiswick from seed sent by Forbes from Rio de Janeiro to the Horticultural Society of London (holotype: CGE, photo: MICH!).

*Banisteria mutabilis* Vellozo, Fl. flum. 193, Icones 4: t. 168. 1829.—TYPE: unknown.

*Thryallis rotundifolia* A. Gray, U.S. Expl. Exp. 15(1): 264. 1854.—TYPE: BRAZIL. Rio de Janeiro, *U.S. Expl. Exp. 873* (lectotype, here designated: US!, photo: MICH!, isolectotypes: GH! K!).

*Thryallis ovatifolia* Niedenzu, Bot. Jahrb. Syst. 14, Beibl. 30: 5. 1891. *Thryallis latifolia* var. *ovatifolia* (Niedenzu) Niedenzu, Arbeiten Bot. Inst. Königl. Akad. Braunsberg 5: 12. 1914.—TYPE: BRAZIL. Rio de Janeiro: "ad radices montium Serra d'Estrella" (fide Niedenzu), *Glaziou 12487* (holotype: B, destroyed, fragment: NY!; isotypes: G! K ! P!, photo of G isotype: MICH!).

*Thryallis brachystachys* var. *obtusa* Niedenzu, Arbeiten Bot. Inst. Königl. Akad. Braunsberg 5: 12. 1914.—TYPE: BRAZIL. Rio de Janeiro, *Glaziou 1058* (lectotype, here designated: BR!, photo: MICH!).

Scandent shrubs to woody vines to 8 m. Laminas 6–14 cm long, 3.8–7.5 cm wide, elliptical to broadly lanceolate to sometimes suborbicular, apex apiculate or obtuse-apiculate or acuminate, abaxially very densely stellate-pubescent with a mixture of subsessile to short-stalked hairs [the stalks up to 0.1 (–0.2) mm long, the 7–12 branches 0.02–0.2 mm long] and sessile hairs with 8–12 (–15) branches 0.01-0.1 mm long, the epidermis hidden; with a pair of prominently raised glands (sometimes branched) at the apex of the petiole, each gland 0.1–1 mm long, 0.5–1.5 mm in diameter, or with the pair of glands flush or slightly sunken at base of the lamina, sometimes also with a second prominent pair along the margin near the base, each gland ca 0.5 mm in diameter, or rarely glands absent; adaxially the costa impressed but the secondary veins only slightly so or not at all impressed, abaxially the costa prominently raised, the secondary veins prominulous, and the tertiary veins indistinct and mostly hidden by the dense indumentum; petioles 0.3–1.8 cm long; stipules 0.5–1.7 mm long, 0.4–0.8 mm wide. Flowers (6–) 10–20 per axis; peduncles (0.5–) 2–4.5 mm long, pedicels (6–) 7.5–14 mm long, pedicels 2.4–9 (–13) times as long as the peduncles; bracts 1.2–2.5 mm long, 0.6–1 mm wide, bracteoles 1–1.5 mm long, 0.4–0.5 mm wide, bracts and bracteoles mostly deciduous during anthesis but frequently some retained in fruit (caducous in specimens from Paraguay). Sepals in flower (5.5–) 6–6.5 mm long, 3.5–5 mm wide, elliptical to broadly elliptical, in fruit (7.5–) 9–11 mm long, (3.5–) 4.5–6 mm wide. Lateral petals: claw 4–5.5 mm long, limb 7–8 mm long, (9–) 10–11 mm wide; posterior petal: claw 2.8–3.5 (–4.5) mm long, limb 7.5–8 mm long, (9–) 10–11 mm wide. Filaments (1.5–) 2–2.3 mm long, anthers of stamens opposing petals 1.5–2 mm long, of those opposing sepals 1.8–2.3 mm long. Anterior style (3–) 4–5 mm long, longer than the posterior two; posterior styles (2.7–) 3.5–4 mm long; stigma 0.3–0.4 mm long. Nutlets 4–4.5 mm high, with a dorsal ridge or winglet up to 1.5 mm wide; outer cotyledon ca 4 mm long, ca 2.5 mm wide, the distal 1/3 folded over the inner cotyledon, inner cotyledon ca 5.4 mm long, ca 2 mm wide, folded over at the distal 4/5. Fig. 2j.

Phenology. Collected in flower from December to June, in fruit from December to July.

Distribution (Fig. 1). Brazil (eastern Minas Gerais and Bahia to Santa Catarina) and eastern Paraguay; along seashore, in restingas, caatingas, capoeiras, woods, and at roadsides; sea level to 1000 m.

ADDITIONAL SPECIMENS EXAMINED. **Brazil.** BAHIA: Mpio. Jequié, ca 4 km a E de Jequié, *Mori & dos Santos 11833* (MICH); Itaberaba, BA-046, Itaberaba/Iaçu, a 10 km ao S de Itaberaba, *Mori 13427* (MICH, NY); Jequié, *Belém & Mendes 202* (UB, US).—ESPIRITO SANTO: Vitória–V. Velha, *Brade 18083* (RB).—MINAS GERAIS: ca 5 km NE of Francisco Sá, rd to Salinas, *Irwin et al. 23213* (F, MICH, MO, NY, RB, UB, US); Inhapim, 19°30'S, 42°W, *Lindeman & de Haas 4572* (NY, WIS).—PARANÁ: Mpio. Adrianópolis, Col. 7 Barras, *Hatschbach 37839* (MICH, MO, NY, SP).—RIO DE JANEIRO: Rio de Janeiro, *Barboza s.n.* (BR); Nictheroy, Jurujuba, *Brade 216* (GH), *10040* (R), *11364* (US); Itaipuassú, *Brade 14155* (RB); Rio de Janeiro, *Burchell 1853* (GH, K); Nouvelle Fribourg, [Oct 1842] *Claussen 33* (G); without locality, *Claussen 31* (G), *Claussen 38* (BM); Rio de Janeiro, *Dusén 180* (F, G, US); Rio de Janeiro, *Glaziou 723* (BR, K); without locality, *Guillemin 33* (G, P); base de Corcovado, le long de l'aqueduc, *Guillemin 160* (F, G, NY, P, RB); route de S. Clemente, *Guillemin 731* (P); *Houllet s.n.* (BR); Rio de Janeiro, *J. G. Kuhlmann RB15920* (RB); Serra dos Orgãos, *Martius 535* (BM, BR, G, GH, K, M, MO, NY, P); without locality, *Raben 382* (BR); Rio de Janeiro, *Riedel 365* (NY); Faz. Chanaan, Campos, *Sampaio 7893* (R); without locality, *Schott s.n.* (G), *Schüch s.n.* (BR); Santa Teresa, *Schwacke 2950* (RB); Itapirú, *Schwacke 7333* (RB); Praia de Grumari, próximo à Guaratiba, *L. B. Smith 6542* (US); estrada p. Irmação dos Busios, *Sucre 1442* (MICH, UB); Rio de Janeiro, *Vauthier 119* (G), *Vauthier s.n.* (G, K, P); Cabo Frio, *Vidal R39271* (R); Rio Janeiro, *Widgren 741* (BR).—SANTA CATARINA: Porto Belo, Ponta da Enseada, *Cervi 2607* (MBM, MICH); Morro do Ribeirão, *Klein 7049* (MICH, P); *Mueller 188* (K); Sabiá, Vidal Ramos, *Reitz & Klein 6561* (MICH, P, US); Capivary bei Tuberão, *Ule 1007* (NY-fragment, P, US).—SÃO PAULO: Amparo, *de Araujo SP20939* (GH, SP); without locality, *Gaudichaud 47* (P); Ribeira, *Hatschbach 2956* (K, MICH, RB); Monte Alegre do Sul, Faz. Nossa Senhora da Encarnação, *Kuehn & M. Kuhlmann 1143* (SP), *M. Kuhlmann 1785* (SP); Amparo, *Recch SP17819* (SP); Estação de Cunha, *Viegas et al. RB42113* (RB).—Without locality: *Pohl s.n.* (M); *Pohl d.1539* (BR), *Wied Neuwied s.n.* (BR). **Paraguay.** ALTO PARAGUAY: Collina Yaté, ca 80 km ad meridiem Fuerte Olimpo, *Bernardi 20452* (MO).—AMAMBAY: cerca del Parque Nacional Cerro Corá, junto a Gas Ory, *Fernández Casas 6119* (MO, NY); 20 km al N del cruce de Bellavista y Pedro Juan Caballero, *Fernández Casas 6184* (MO, NY); Estáncia Santa Teresa, *Soria 4479* (MO).—CONCEPCIÓN: zwischen Río Apa und Río Aquidaban, *Fiebrig 4530* (BM, G, GH, K, M, NY-fragment); entre Paso Horqueta y Concepción, *Krapovickas et al. 14231* (MICH); Puerto Fonciere, 10 km al N, sobre Río Paraguay, *Palacios 1949* (MO).

The disjunction between the Paraguayan populations and those from eastern Brazil is surprising; however, the plants do not differ in any aspect. Perhaps additional collections from Paraguay, especially in fruit (none are available now), may reveal characters that would permit recognition of the Paraguayan element at subspecific rank.

**Thryallis laburnum** S. Moore, Trans. Linn. Soc. London, ser. 2, Bot. 4: 324. 1895. *Thryallis latifolia* var. *acuminata* f. *laburnum* (S. Moore) Niedenzu, Arbeiten Bot. Inst. Königl. Akad. Braunsberg 5: 12. 1914.—TYPE: BRAZIL. Mato Grosso do Sul: prope Corumbá, Jan 1892, *Moore 970* (lectotype, here designated: BM!, photo: MICH!; isolectotypes: K! NY!).

*Thryallis laburnum* var. *minor* S. Moore, Trans. Linn. Soc. London, ser. 2, Bot. 4: 324. 1895. *Thryallis brachystachys* var. *acuminata* Niedenzu, Arbeiten Bot. Inst. Königl. Akad. Braunsberg 5: 12. 1914, nom. superfl.—TYPE: BRAZIL. Mato Grosso do Sul: prope Corumbá, Jan 1892, *Moore 969* (holotype: BM!, photo: MICH!; isotype: NY!).

Scandent shrubs to woody vines to ca 3 m (fide Moore). Laminas 6.5–12 cm long, 3.5–8 cm wide, elliptical to broadly ovate, apex acuminate or sometimes apiculate, abaxially the younger laminas and the reduced ones near and in the

inflorescence densely stellate-pubescent with a mixture of long- and short-stalked hairs [the stalks 0.01–0.1 mm long, the 6–11 branches (0.04–) 0.1–0.2 (–0.3) mm long] as well as sessile hairs with 8–10 branches (0.01–) 0.03–0.1 mm long, in mature leaves only the stalked hairs retained and the epidermis readily visible; with a prominently raised pair of glands at the apex of the petiole, each gland 0.2–0.5 mm long, 0.7–1.2 mm in diameter, rarely also with a second prominent pair along the margin near the base, each gland ca 0.5 mm in diameter, adaxially the costa impressed but the secondary veins only slightly or not at all impressed, abaxially the costa and secondary veins prominently raised, the tertiary veins prominulous; petioles 0.7–2 cm long; stipules 0.7–1 mm long, 0.4–0.5 mm wide. Flowers 10–18 per axis; peduncles 1–3.5 mm long, pedicels 6–13 mm long, pedicels 2.7–6.4 times as long as the peduncles; bracts 1.5–2.8 mm long, 0.5–0.7 mm wide, bracteoles 0.9–1.2 (–1.7) mm long, 0.3–0.4 mm wide, bracts and bracteoles caducous (seen only in youngest parts of inflorescence). Sepals in flower 5.7–7 mm long, (3.5–) 4–5 mm wide, elliptical to broadly elliptical, in fruit 9–11.3 mm long, (3–) 3.5–4.3 mm wide. Lateral petals: claw 4.5–6 mm long, limb 6.5–8 mm long, (9–) 10–12 mm wide; posterior petal: claw 3.5–4 mm long, limb 7.5–8 mm long, (9–) 10–11 mm wide. Filaments 1.7–2.2 mm long, anthers of stamens opposing petals 1.6–2 mm long, of those opposing sepals 2–2.4 mm long. Anterior style 3–3.7 mm long, longer than the posterior two; posterior styles 2.7–3.2 mm long; stigma 0.3–0.4 mm long. Nutlets ca 4 mm high, with a dorsal ridge or winglet to 2 mm wide; outer cotyledon ca 6 mm long, ca 3.5 mm wide, the distal 2/5 folded over the inner cotyledon, inner cotyledon ca 5.5 mm long, ca 2 mm wide, folded over at the distal 2/5. Fig. 2k.

Phenology. Collected in flower in January and February, in fruit in February and May.

Distribution (Fig. 1). Brazil (Mato Grosso do Sul), Bolivia (Santa Cruz), and Paraguay (Alto Paraguay); dry and secondary forest and at roadsides; 100–300 m.

Additional Specimens Examined. **Bolivia.** Santa Cruz: Quiapaca, 10 km N of Santiago, valley of Río Tucuvaca, 18°20'S, 59°30'W, *Gentry 73895* (MICH, MO). **Brazil.** Mato Grosso do Sul: Corumbá, *Fróes 11690* (A, F, MO, NY), *Hoehne SP30251* (SP), *Robert 762* (BM). **Paraguay.** Alto Paraguay: [vicinity of Fort Olimpo, fide Urban (1916)] *Weddell 3017* (P).

**Thryallis latifolia** Martius, Nov. gen. sp. 3: 79. 1829. *Hemsleyna latifolia* (Martius) Kuntze, Rev. gen. pl. 1: 88. 1891. *Thryallis latifolia* var. *acuminata* Niedenzu, Arbeiten Bot. Inst. Königl. Akad. Braunsberg 5: 11. 1914.—Type: Brazil. Bahia: "in herbidi udis ad canalem Dique prope Soteropolin," *Martius s.n.* (holotype: M!; photo: MICH!).

Scandent shrubs to woody vines to 3 m. Laminas 7.5–13.2 cm long, 4.6–10.2 cm wide, elliptical to broadly ovate to rarely suborbicular, apex apiculate or emarginate-apiculate to acuminate, abaxially densely stellate-pubescent with a mixture of short– and long-stalked hairs [the stalks 0.04–0.3 (–0.4) mm long, the 7–13 branches (0.04–) 0.1–0.3 mm long] as well as sessile hairs with 9–19 branches 0.02–0.2 (–0.3) mm long, the epidermis hidden, with a prominently raised pair of glands (sometimes branched, rarely peglike) at the apex of the petiole, each gland 0.3–1 (–2) mm long, 0.7–1.2 mm in diameter, sometimes also with a second prominent pair at the base of the lamina or along the margin near the base, each gland 0.5–1 mm in diameter; rugose, adaxially the costa and veins impressed, abaxially the

costa and veins prominently raised; petioles 0.8–1.2 cm long; stipules 1–1.5 mm long, 0.5–0.7 mm wide. Flowers 12–22 per axis; peduncles 1.5–3.5 mm long, pedicels 8.5–13.5 mm long, pedicels 2.8–6.6 times as long as the peduncles; bracts 1.8–4.5 mm long, 1–1.3 mm wide, bracteoles 1–1.5 mm long, 0.4–0.6 mm wide, bracts and bracteoles deciduous during anthesis. Sepals in flower 5–5.5 mm long, 4–4.5 mm wide, elliptical, in fruit (7–) 9–10.5 mm long, 3.5–4.7 mm wide. Lateral petals: claw ca 6 mm long, limb 10–11 mm long, 13–14 mm wide; posterior petal: claw ca 4 mm long, limb ca 10 mm long, ca 13.5 mm wide. Filaments ca 2 mm long, anthers of stamens opposing petals ca 1.8 mm long, of those opposing sepals ca 2.2 mm long. Anterior style ca 3.2 mm long, longer than the posterior two; posterior styles ca 2.7 mm long; stigma 0.3–0.4 mm long. Nutlets 3.5–4 mm high, with a dorsal ridge up to 0.3 mm wide, rarely expanded into a winglet up to 1.5 mm wide; mature seed not seen. Fig. 2l.

Phenology. Collected in flower from January to May, in fruit from March to June.

Distribution (Fig. 1). Brazil (Minas Gerais and adjacent São Paulo); in campo, campo sujo, and at forest edge.

Additional Specimens Examined. **Brazil.** Minas Gerais: Mpio. Santa Luzia, Lagôa Santa, *Barreto 4768* (F); Mpio. Belo Horizonte, Jardim Botanico, *Barreto 7475* (F, UB, US); Mpio. Belo Horizonte, Gorduras de Cima, *Barreto 8680* (UB); Ouro Preto, *Campos SP18840* (SP); without locality, *Claussen s.n. (523)* in 1838 (F, G, GH, NY), *Claussen s.n. (40A)* in 1840 (BM, BR, G, NY, RB), *Claussen 41A* in 1840 (BR), *Claussen 42A* in 1840 (BR, G, M), *Claussen 128* (BM), *Claussen 409* (BR), *Claussen 413* in 1840 (BM, G), *Claussen 585* in 1840 (G), *Claussen 587* in 1840 (G), *Claussen 1413* in 1840 (BR, G); chemin de la Serra da Piedade, *Damazio 861* (G); bords du Rio Paranna [sic], *Glaziou 18946* (K, P); Caraça, *Gounelle s.n.* (P); Morro do Paú Lavrado, *Heringer 3815* (SP, UB, US); Hôrto Florestal de Paraopeba, *Heringer 7159* (UB); without locality, *Langsdoff & Riedel 781* (NY); Mpio. Belo Horizonte, Mazargão, *Roth RB1808* (RB); without locality, *Saint-Hilaire 124AC* (P); Sabará, *Vauthier 558* (G, P); Mpio. Nova Lima, Serra da Mutuca, *Williams & Assis 5384* (GH); Mpio. Belo Horizonte, Morro das Pedras, *Williams & Assis 6329* (GH); Mpio. Belo Horizonte, Resaca, near Pampulha, *Williams & Assis 7395* (US).—São Paulo: Via Anhuanguera, 1 km S de Ituperava, *Hatschbach 42788* (MICH).

The type of *Thryallis latifolia* is said to be from wet places at the large ditch or moat, "Dique," at the fortification of Saõ Pedro in the city of Salvador Bahia. It is likely that the type was mislabeled. All other collections seen are from Minas Gerais, and *Thryallis* is not found in wet localities.

**Thryallis longifolia** Martius, Nov. gen. sp. 3: 78, t. 230. 1829. *Hemsleyna longifolia* (Martius) Kuntze, Rev. gen. pl. 1: 88. 1891.—Type: Brazil. Bahia: in sylvis catingas ad Mt. Sanctum [Monte Santo], *Martius s.n.* (holotype: M!, photo: MICH!; isotype: M! P-JU, photo of P-JU isotype: MICH!).

Scandent shrubs to woody vines to 10 m. Laminas 6.3–20.5 cm long, 3.2–14 cm wide, elliptical to lanceolate to broadly ovate, apex obtuse-apiculate or apiculate-emarginate to acuminate, abaxially stellate-pubescent with stalked hairs (the stalk 0.1–0.3 mm long, the 7–10 branches 0.04–0.3 mm long, in longer hairs the branches radiating from the apex only, the shorter hairs commonly with a stouter stalk and the branches radiating from along the stalk as well), sessile hairs absent and the epidermis visible; the reduced leaves associated with the inflorescence sometimes pubescent adaxially and densely pubescent abaxially; with a pair of prominently raised to knob- or peglike glands at the apex of the petiole, each gland 0.5–3.5 mm long, 0.5–0.7 mm in diameter, sometimes branched, often also with a second prom-

inent pair at the base of the lamina or along the margin near the base, each gland 0.5–1 mm in diameter; adaxially the costa impressed and the secondary veins less deeply or not at all impressed, abaxially the costa and secondary veins prominently raised, the tertiary veins prominulous; petioles 0.6–2 cm long; stipules 0.8–2.3 mm long, 0.4–0.7 mm wide. Flowers (6–) 10–20 per axis; peduncles 0.5–3.5 mm long, pedicels 10–23 mm long, pedicels 4–13 times as long as the peduncles; bracts 1.8–3.2 mm long, (0.4–) 0.6–1 mm wide, bracteoles 1–2 mm long, 0.4 mm wide, bracts and bracteoles usually deciduous early in anthesis, commonly associated only with buds, sometimes retained through fruiting stage. Sepals in flower 4.6–7 mm long, 3.6–5.8 mm wide, broadly elliptical to broadly ovate, in fruit 8.5–10.5 mm long, 3.8–6.5 mm wide. Lateral petals: claw 6–7.5 mm long, limb 7–10 mm long, 11–14 mm wide; posterior petal: claw 3.5–4.5 mm long, limb 9–10 mm long, 11–13 mm wide. Filaments 1.8–2.3 mm long, anthers of stamens opposing petals 1.9–2.2 mm long, of those opposing sepals 2–2.5 mm long. Anterior style 2.9–3.8 mm long, longer than the posterior two; posterior styles 2.6–3.2 mm long; stigma 0.3–0.5 mm long. Nutlets 3.6–4.2 mm high, with a dorsal ridge or winglet up to 1.5 mm wide; outer cotyledon ca 4 mm long, ca 2.1 mm wide, the distal 1/3 folded over the inner cotyledon, inner cotyledon ca 1.5 mm long, ca 1.9 mm wide, folded over at the distal 1/2. Fig. 2a–i.

Phenology. Collected in flower from December to April, and in fruit from December to August.

Distribution (Fig. 1). Eastern Brazil (Ceará, Rio Grande do Norte, Paraíba, Pernambuco, Bahia, and eastern Minas Gerais; probably also in Alagoas and Sergipe); caatingas, woodlands, roadsides, on limestone and granite; 50–1130 m.

Additional Specimens Examined. **Brazil.** Bahia: 18 km NW of Conceição do Coité on rd to Santaluz, ca 11°30'S, 39°20'W, *Anderson 11739* (MICH, MO, NY); 3 km S of Senhor do Bonfim, 10°25'S, 40°10'W, *Anderson 11741* (BR, MICH, MO, NY); Mpio. Poções, 2.5 km W of Poções on rd to Bom Jesus da Serra, *Anderson 12515* (MICH, RFA); Mpio. Jacobina, 20 Km E of Jacobina on rd to Capim Grosso, *Anderson 13692* (MICH); Jacobina, *Blanchet 3628* (BR, F, G, K, MO, P); Rod. Juazeiro–Senhor do Bonfim (BR-407), Km 100, 10°19'S, 40°10'W, *Coradin et al. 5998* (K); Porto Castro Alves Cachoeira, vale dos rios Cachoeira e Jacuípe, 12°32'S, 39°05'W, *do Cavalo 1017* (MICH); Mpio. Senhor do Bonfim, Fazenda Campo Verde, *Döbenreiner & Tokarnia 1477* (MICH); Mpio. Jequié, ao SW do Km 38 da Rod. Jequié–Contendas do Sincorá, *dos Santos et al. 3491* (MICH, NY); Mpio. Poções, perto de Victória da Conquista, 5 km entrando na estrada para Boa Nova, *Gottsberger & Gottsberger 25-25173* (NY); Serra de Itiuba ca 6 km E of Itiuba, ca 10°41'S, 39°48'W, *Harley 16195* (K, MICH, MO, NY, RB); Monte Santo, ca 10°27'S, 39°20'W, *Harley 16429* (K, MICH, NY); ca 2 km from Estiva, ca 12 km N of Senhor do Bonfim on BA-130 to Juazeiro, ca 10°23'S, 40°10'W, *Harley 16516* (MICH, MO, NY); Morro de Nossa Senhora dos Milagres, just W of Milagres, 12°54'S, 39°52'W, *Harley 19461* (MICH, NY, RB, US); valley of the Rio das Ondas, ca 5 km E of Barreiras, *Irwin 31638* (F, MICH, NY, RB, SP); Senhor do Bonfim, Serra de Santana, *Lewis et al. SPF 36619* (MICH); Mpio. Poções, Km 2–4 da estrada que liga Poções (BR-116) ao povoado de Bom Jesus da Serra (ao W de Poções), *Mori et al. 9491* (MICH, NY); Jacobina, 11°16'S, 40°27'W, *Orlandi 256* (RB, UB). Ceará: Aracatí, *Fernandes & Matos EAC3130* (MICH); Estação Ecológica de Aiuaba, *Martins EAC10187* (MICH).—Minas Gerais: Mpio. Datas, 5 km E of Datas on rd to Serro, *Anderson 13657* (MICH); ca 10 km S of Serra do Cipó at Cardeal Mota, *Anderson 36271* (F, MICH, MO, NY, UB, US); S. Paraíso, Faz. Fortaleza, *Brade 17801* (RB); ca 2 km N of Joaquim Felício, *Irwin 27358* (F, G, MICH, MO, NY, UB); Felixlandia para Brasília, *Pires 57941* (MICH, NY); Serra de Pitangui (fide Niedenzu, 1928), *Sellow III. it. B1851 c1322* (NY); without locality, *Saint-Hilaire 180A* (P).—Paraíba: Encosta do Pico do Jabre–Teixeira, *Fernandes & Matos EAC6633*, (MICH).—Pernambuco: Triunfo, *Heringer et al. 934* (RB, UB); Inajá, *Heringer et al. 980* (RB, UB); Serra Catingueira, *Lützelburg 25770* (F, M).—Rio Grande do Norte: Mossoró, Olho d'Água da Escada, *Tavares 714* (US).

**Thryallis parviflora** C. Anderson, n. sp.—TYPE: BRAZIL. Distrito Federal: Córrego Landím, ca 20 km N of Brasília, gallery forest and creek margin, 950 m, 16 Dec 1965, *Irwin 11341* (holotype: RB!, photo: MICH!; isotypes: F! MO! NY! UB! US!).

Differt a Thryalle latifolia petiolo infra apicem 2 (–4) glandulis longe stipitatis (usque 5.5 mm) instructo et petalis parvulis (limbo usque 6 mm longo et 8 mm lato).

Scandent shrubs to woody vines to 5 m. Laminas 8.5–13.5 cm long, 5–9.5 cm wide, narrowly elliptical to elliptical to ovate, apex apiculate or emarginate-apiculate to acuminate, abaxially densely stellate-pubescent with a mixture of short- and long-stalked hairs (the stalks 0.05–0.3 mm long, the 5–8 branches 0.1–0.3 mm long) and sessile to subsessile hairs (stalk up to 0.01 mm long, the 5–8 branches 0.03–0.08 mm long) as well as sessile hairs with 8–12 branches 0.01–0.06 (–0.09) mm long, the epidermis hidden; with a pair of knob- to peglike glands at the apex of the petiole or at the base of the lamina at insertion of petiole, each gland 1.4–5.5 mm long, 0.5–1.4 mm in diameter, sometimes branched and the second pair smaller; rugose, adaxially the costa and veins impressed, abaxially the costa and veins prominently raised; petioles 1–1.8 cm long; stipules 1–2.5 mm long, 0.6–0.8 mm wide. Flowers 12–22 per axis; peduncles 0.5–3 mm long, pedicels 7–11.5 mm long, pedicels 3.1–9 (–17) times as long as the peduncles; bracts 2–4.2 mm long, 1–1.6 mm wide, bracteoles 1.5–2.8 mm long, 0.5–0.8 mm wide, bracts and bracteoles deciduous or persistent during anthesis and sometimes retained in fruit. Sepals in flower 5.5–6 mm long, 3.5–4 mm wide, elliptical, in fruit 8–9 mm long, 3–4 mm wide. Lateral petals: claw 4–5 mm long, limb 4–5.5 (–6) mm long, 6–8 mm wide; posterior petal: claw 2–3.5 mm long, limb 4–5.5 mm long, 6–8 mm wide. Filaments 1.5–2 mm long, anthers of stamens opposing petals 1.7–1.9 mm long, of those opposing sepals 2–2.4 mm long. Anterior style 2.7–3.1 mm long, longer than the posterior two; posterior styles 2.4–2.7 mm long; stigma 0.3–0.4 mm long. Nutlets ca 3.8 mm high, with a dorsal ridge up to 0.2 mm wide; mature seed not seen. Fig. 2m, n.

Phenology. Collected in flower in January, October, and December, in fruit from April to June.

Distribution (Fig. 1). Brazil (Distrito Federal and Goiás); in gallery forest, capoeira, secondary woods, and cerrado; 900–950 m.

ADDITIONAL SPECIMENS EXAMINED. **Brazil.** DISTRITO FEDERAL: Brasília, camino de Fercal, *Barroso 609* (RB); Brasília, Sobradinho, Fercal, *Heringer 14262* (K, MICH); Chapada da Contagem, ca 10 km E of Brasília, *Irwin 15733* (MICH); Brasília, *Pires et al. 9304* (UB); Brasília, Fundação Zoobotânica, *Pires et al. 9574* (NY, UB, US); Felixlândia para Brasília, *Pires 57941*(UB).—GOIÁS: Mpio. Formosa, JK, *Hatschbach 39355* (MICH); Rio Contagem, ca 35 km N of Brasília, *Irwin 15733* (NY, UB); Itumbiara, proximo o Rio Paranaíba, *Rizzo 8704* (MICH).

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# NOTES ON NEOTROPICAL MALPIGHIACEAE—V

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Ann Arbor, Michigan 48109-1057

This paper contains another miscellany of new species, new combinations, and lectotypifications. It is clear that many undescribed Malpighiaceae still await our attention, especially in South America. This modest contribution represents one step in the long journey toward the goal of knowing and understanding the Malpighiaceae of the New World.

**Banisteriopsis cornifolia** (H. B. K.) C. B. Rob. ex Small var. **maracaybensis** (Adr. Juss.) W. R. Anderson, comb. nov. *Banisteria maracaybensis* Adr. Juss., Ann. Sci. Nat. Bot., Sér. 2, 13: 285. 1840. *Banisteria maracaybensis* var. *elliptica* Nied., Ind. Lect. Lyc. Reg. Hos. Brunsberg. p. hiem. 1900–1901: 5. 1900. *Banisteria cornifolia* var. *elliptica* (Nied.) Nied. in Engler, Pflanzenreich IV. 141: 405. 1928. *Banisteriopsis cornifolia* var. *elliptica* (Nied.) B. Gates, Fl. Neotr. 30: 42. 1982.—TYPE: VENEZUELA. Zulia: Maracaibo, *Plée s.n.* (holotype: P!; isotypes: BR! [lectotype of *Banisteria maracaybensis* var. *elliptica*], F!, P!, P-JU!).

**Banisteriopsis mathiasiae** (W. R. Anderson) W. R. Anderson, comb. nov. *Stigmaphyllon mathiasiae* W. R. Anderson, Bol. Mus. Bot. Munic. (Curitiba) 43: 3. 1981.—TYPE: PERU. Ucayali (formerly Loreto): Pucallpa–Aguaytía road, Km 34 just W of Tournavista, *Mathias & Taylor 6078* (holotype: MICH!; isotypes: COL!, F!, LA!, MBM!, MO!, NY!, RB!, U!, US!, USM!).

This anomalous species bears resemblances to both *Banisteriopsis* and *Stigmaphyllon*. I originally described it in *Stigmaphyllon* because Bronwen Gates did not welcome it in *Banisteriopsis*. Now Christiane Anderson, who is completing a monograph of *Stigmaphyllon*, adamantly rejects it as a member of that genus, and B. Gates, while still not keen, is willing to tolerate it in *Banisteriopsis*.

*Banisteriopsis mathiasiae* seems to belong in subgenus *Banisteriopsis*, and to be most closely related to *B. megaptera* B. Gates and *B. ferruginea* (Cav.) B. Gates, both species of eastern Brazil. It is easily distinguished by its much larger leaves with large protruding glands at the apex of the petiole, one character that makes it look like a *Stigmaphyllon*. However, the most dramatic character of this species, and the one that most recalls *Stigmaphyllon*, is the structure of the inflorescence. In *B. mathiasiae* the inflorescence is strongly cymose—the first flowering axis is relatively short and densely flowered, while the subtending secondary branches are long-stalked and generally overtop it. This pattern may be repeated as the inflorescence continues development, producing the kind of dichasial effect that gives species of *Stigmaphyllon* their characteristic aspect. In related species of *Banisteriopsis* the side branches are shorter, producing an effect that is more paniculate than cymose, and in at least some cases the maturation of flowers

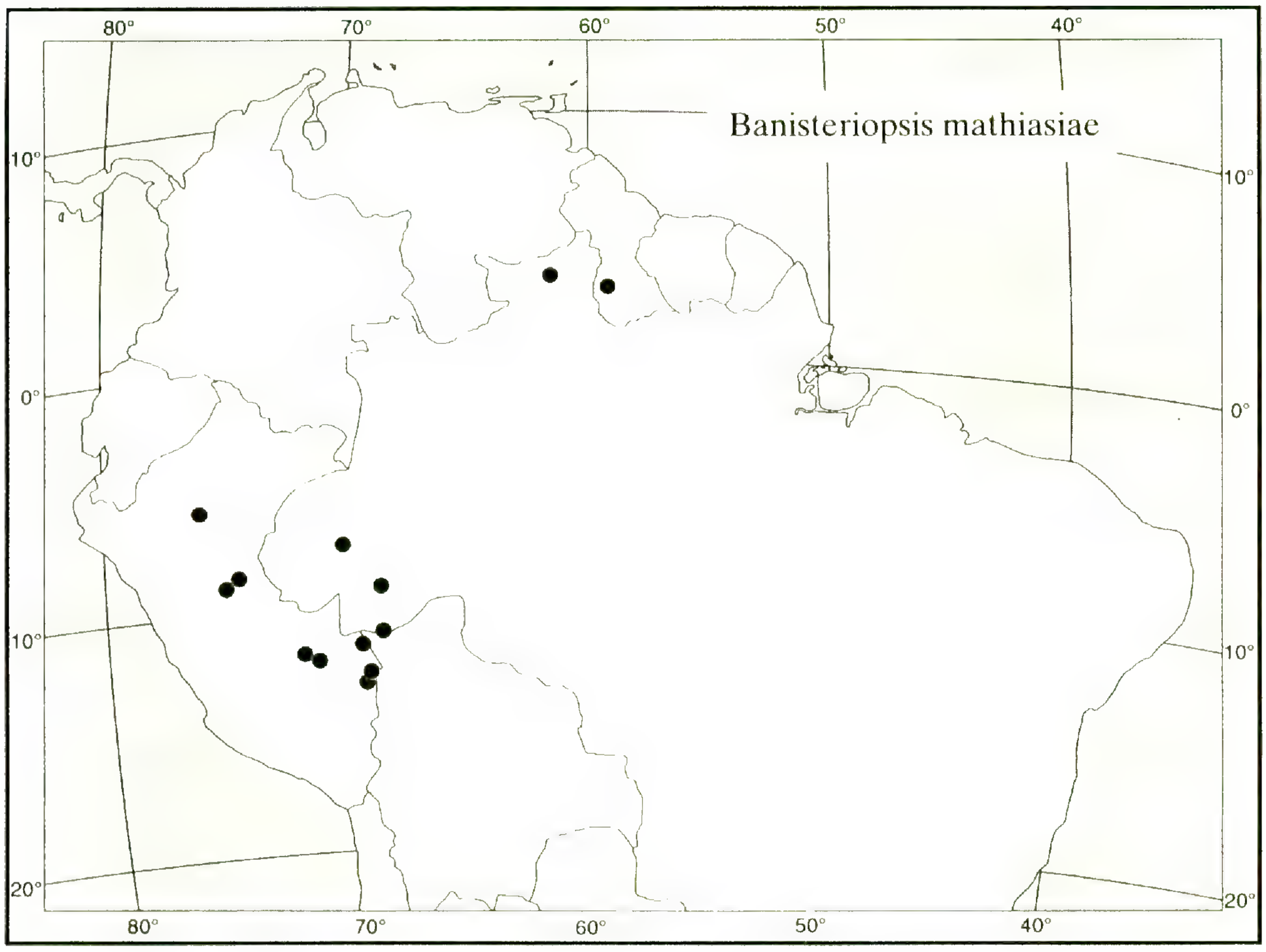


FIG. 1. Distribution of *Banisteriopsis mathiasiae*.

seems to be from the lower branches toward the upper, or truly paniculate. So the inflorescence that gives *B. mathiasiae* its distinctive resemblance to a *Stigmaphyllon* may result from a fundamental change in the timing of its development, or from a simple difference in the amount of elongation of side branches, but in any case I am now satisfied by the other evidence, especially from the flowers, that this species belongs in *Banisteriopsis.*

*Banisteriopsis mathiasiae* has a rather wide distribution in southwestern Amazonia (Fig. 1), being known now from the departamentos of Loreto, Ucayali, Huánuco, and Madre de Dios in Peru, and from Acre and nearby Amazônas in Brazil. It also occurs in northeastern Amazonia, in the Reserva Ecológica Maracá, Ilha de Maracá, Territorio Roraima, Brazil, and in the Rupununi district of Guyana. Such transamazonian disjunctions are known in other groups of Malpighiaceae, so while this pattern is surprising and fascinating, it is not without precedent. In fact, *Banisteriopsis cinerascens* (Bentham) B. Gates, another species of subgenus *Banisteriopsis*, has a very similar distribution.

**Bunchosia anomala** W. R. Anderson, sp. nov.—TYPE: COLOMBIA. Antioquia: Mpio. Pto. Berrío, vereda Alicante, 1 km S de finca Pénjamo, en la via de San Juan de Bedout–La Cabaña, 6°39'N, 74°33'W, 500 m, bosque perturbado, frecuente, 2 Mar 1990 fl, *Callejas, Roldán & Maza 9292* (holotype: MICH!; isotype: NY!). Fig. 2.

Arbor 12 m alta, ramis primo sparsim sericeis mox glabratis. Lamina foliorum majorum 8.5–10.5 cm longa, 4.5–5.5 cm lata, sparsim sericea vel glabrata. Inflorescentia ramum bifoliatum terminans, ex minimum 24–30 floribus constans. Petalum

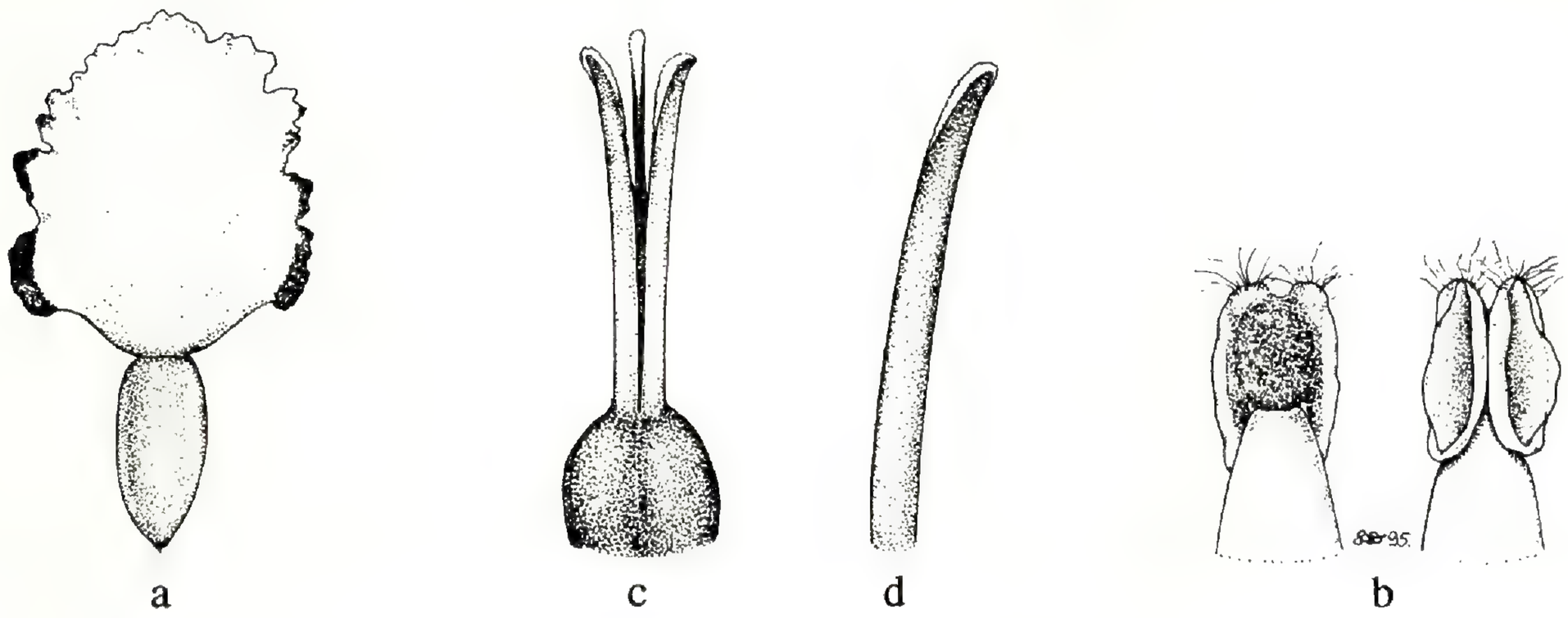


FIG. 2. *Bunchosia anomala*. a) posterior petal, adaxial view, ×4.7; b) anthers, abaxial view (left) and adaxial view (right), ×10; c) gynoecium, ×6.7; d) style tip, lateral view, showing the elongated stigma, ×13.3. Drawn by Karin Douthit from the holotype.

posticum ungue 3 mm longo, 1.8 mm lato, crassissimo, apice constricto, limbo 6 mm longo, 5 mm lato, margine proximaliter crasse glanduloso. Antherae 1.2–1.5 mm longae, apice tomentosae, connectivo brunneolo. Ovarium 3-carpellatum, glabrum; styli 3, liberi, 3.5 mm longi, stigmatibus elongatis, 0.7–0.9 mm longis.

Tree 12 m tall; stems initially very sparsely sericeous with short translucent appressed hairs, soon glabrate. Lamina of larger leaves 8.5–10.5 cm long, 4.5–5.5 cm wide, elliptical, cuneate at base, acuminate at apex with the very tip glandular and often slightly retuse, bearing 2 (–3) large glands abaxially near midrib ca 1 cm above base, very sparsely sericeous to glabrate on both sides, the hairs persisting longer above than below; petiole 5–7 mm long, sparsely sericeous to glabrate, eglandular or bearing a small bulbous gland at base just above one of the stipules; stipules 0.5–0.8 mm long, borne on adaxial face of petiole at base, ovate, abaxially hairy, adaxially glabrous. Inflorescence a pseudoraceme terminating a lateral shoot with a pair of full-sized vegetative leaves, loosely sericeous, ca 10 cm long (very young, surely not fully elongated), the 24–30 or more flowers mostly decussate but with the regularity sometimes decaying distally; bracts (except the proximal pair, which are often 5–9 mm long and linear) 1.5–2 (–2.5) mm long, triangular or ovate; peduncle 3–4.5 mm long; bracteoles apical, 1–1.2 mm long, triangular or ovate, one or occasionally both bearing an eccentric abaxial gland 0.7–1.2 mm in diameter; pedicel 2.5–3.5 mm long. Sepals 1.5–2 mm long beyond glands, rounded, glabrous except for the ciliate margin, appressed in anthesis, the glands 10, 3–4 mm long, some connate in pairs, glabrous. Petals yellow, glabrous, the lateral 4 reflexed with the slender claw 3 mm long, the limb 7–8 mm long, most deeply concave in outermost petal, coarsely erose or toothed with the marginal divisions more or less glandular in the proximal half; posterior petal erect, the claw 3 mm long, 1.8 mm wide, very thick, constricted at apex, the limb 6 mm long, 5 mm wide, flat, roughly pentagonal, the margin irregularly dissected and proximally thickly glandular, the glandularity diminishing distally. Filaments 2.2–3 mm long, glabrous, ca 1/2 connate; anthers 1.2–1.5 mm long, each bearing an apical tuft of hairs, pressed against styles in anthesis, the connective light brown. Ovary 1.5 mm high, cylindrical, 3-carpellate, glabrous; styles 3, free, 3.5 mm long, glabrous, each stigma elongated, 0.7–0.9 mm long, linear or slightly dilated at apex, receptive on the internal face, spreading or recurving. Fruit unknown.

*Bunchosia anomala* belongs to a small group of species that have a three-carpellate gynoecium with free styles and the inflorescence terminating a leafy shoot. It most resembles *B. diphylla* (Jacq.) Cuatr. & Croat, but it differs dramatically from that species, and from all other species in the genus, in two characters, the hairy anthers and the elongated stigmas. The latter are most peculiar. In most species of *Bunchosia* the styles have large apical stigmas that appear to be capitate or triangular. In a few the stigma is slightly extended abaxially, e.g., *B. macilenta* Dobson, as described and illustrated in my 1987 article in this series (pp. 60, 65). A somewhat elongated stigma is also found in *B. hartwegiana* Bentham, another Colombian species of this complex. However, nothing I have seen approaches the long, slender stigma found in *B. anomala*. *Bunchosia anomala* is also interesting for the flag petal of its flowers, which has an extraordinarily wide, thick claw that is constricted at the apex. The hairy anthers and long stigmas of this anomalous species will force us to expand somewhat our concept of the morphology of this genus, but there can be no doubt that it belongs in *Bunchosia*, and when it is found with fruits they will probably be similar to those of *B. diphylla*. The type is very young, with only the lowest flowers in each pseudoraceme open, so some of the measurements given above (especially length of the inflorescence, peduncle, and pedicel) will surely change when more mature material is available.

**Bunchosia brevistyla** W. R. Anderson, sp. nov.—TYPE: COLOMBIA. Valle: Mpio. Darién, Hda. Abraham Domínguez, 1800 m, 29 Jun 1988 fl, *Devia A. 2208* (holotype: MICH!; isotype: MO!).

Frutex vel arbor?, ramis primo sericeis mox glabratis. Lamina foliorum majorum 12.3–14.4 cm longa, 5.5–6.7 cm lata, basi cuneata vel rotundata, margine plana, apice late obtusa vel rotundata, maturitate glabra vel costa abaxiali pauci-pilifera. Inflorescentia ramum bifoliatum terminans, ex 10–21 floribus constans. Petalum posticum ungue 3.5 mm longo, 1.2 mm lato, crassissimo, apice aliquantum constricto, limbo 4 mm longo, 3 mm lato, margine distaliter glanduloso-eroso. Antherae 0.9–1.1 mm longae, glabrae, connectivo luteo. Ovarium 2- vel 3-carpellatum, dense tomentosum; styli 2 vel 3, liberi, 1.5–2 mm longi, stigmatibus triangulari-peltatis.

Shrub or tree?, the stems initially sericeous, soon glabrate. Lamina of larger leaves 12.3–14.4 cm long, 5.5–6.7 cm wide, elliptical or somewhat ovate, broadly cuneate or rounded at base, nearly flat at margin, broadly obtuse or rounded at apex, eglandular at apex or with an obscurely glandular tip, bearing 2 abaxial glands at very base beside midrib, glabrous at maturity or with a few appressed hairs on abaxial midrib near base; petiole 8–10 mm long, sparsely sericeous to glabrate, apparently eglandular; stipules ca 1 mm long, borne on adaxial face of petiole at base, ovate, glabrous or abaxially sericeous. Inflorescence a pseudoraceme terminating a lateral shoot with a pair of full-sized vegetative leaves, thinly sericeous with the hairs mostly tightly appressed, 4–8.5 cm long, the 10–21 flowers proximally decussate, distally decussate or in no regular order; bracts (except the proximal pair, which may be up to 4 mm long) 1–2 mm long, ovate; peduncle 1.5–5 mm long; bracteoles apical, 1–1.5 mm long, broadly ovate, one or both bearing 1–2 eccentric abaxial glands 0.5–1.4 mm in diameter; pedicel 2.5–3.5 mm long, loosely sericeous. Sepals 1.5–2 mm long beyond glands, rounded, glabrous except for the ciliate margin, appressed in anthesis, the glands 10, 2.7–3.5 mm long, some connate in pairs, glabrous. Petals yellow, glabrous, the lateral 4 reflexed, the

posterior erect; anterior-lateral petals with the claw slender, 2.5 mm long, the limb ca 5 mm long, concave (especially in the outermost petal), erose at the margin and eglandular or irregularly glandular; posterior-lateral petals with the claw 2 mm long, ca 1 mm wide, constricted at apex, the limb 3.5–4 mm long, nearly flat, erose with the divisions often glandular, especially distally; posterior petal erect, the claw 3.5 mm long, 1.2 mm wide, very thick, somewhat constricted at apex, the limb 4 mm long, 3 mm wide, flat, elliptical, the margin glandular-erose around the distal 2/3. Filaments 2.5–3 mm long, glabrous, ca 1/2 connate; anthers 0.9–1.1 mm long, glabrous, pressed against styles in anthesis, the connective yellow. Ovary 1.7–2 mm high, globose, 2- or 3-carpellate, densely tomentose, especially on the distal 2/3; styles 2 or 3 (as many as the carpels), free, 1.5–2 mm long, glabrous, the stigmas triangular-peltate. Fruit unknown.

*Bunchosia brevistyla* belongs to the same group of species as *Bunchosia anomala*, discussed above. Its closest relative is probably *B. hartwegiana* Bentham, also of Colombia, which differs from *B. brevistyla* in that its leaves have undulate margins, its filaments are about 3.5 mm long, its ovary is glabrous, and its styles are about 3.5 mm long; the epithet *brevistyla* draws attention to the last differentiating character. *Bunchosia hartwegiana* has consistently three-carpellate flowers, whereas in *B. brevistyla* they may be either two- or three-carpellate. Such inconsistency is unusual in this genus, but I have seen it before in *B. mollis* Bentham and *B. plowmanii* W. R. Anderson. One might also compare *B. brevistyla* to *B. cestrifolia* Bentham, another species of Colombia with inflorescences terminating leafy shoots. That species has consistently two-carpellate flowers. Its ovary is loosely hairy, in which it resembles *B. brevistyla*, but the leaves in *B. cestrifolia* are much smaller, with the lamina up to 8 cm long and 3.5 cm wide.

The label with the only known collection of *B. brevistyla* describes the plant as an epiphyte, which seems unlikely to be correct; I expect it to prove to be a shrub or small or medium-sized tree like other species in the genus.

**Byrsonima baccae** W. R. Anderson, sp. nov.—TYPE: VENEZUELA. Amazonas: Depto. Atures, Sierra Maiqualida, sector noroccidental, en pequeño valle afluente izquierdo del Caño Iguana medio, 5°30'N, 65°15'W, 2000 m, sobre rocas y en islas arbóreas adyacentes, 2 Mar 1991 fl, *Huber, Berry & Rosales 13112* (holotype: VEN!; isotype: MICH!).

Frutex vel arbor parva 1–6 m alta, ramis vegetativis glabris. Lamina foliorum majorum 3–4 cm longa, 1.5–2.2 cm lata, basi cuneata, valde revoluta, coriacea, glabra; petiolus 6–8 mm longus; stipulae 1.5–2 mm longae, liberae, rotundatae, abaxialiter glabrae. Inflorescentia floribus singulis vel in cincinno sessili bifloro portatis, bracteis bracteolisque persistentibus; pedicellus 2.5–3 mm longus, rectus in alabastro. Sepala per anthesin appressa. Petala rosea. Antherae 1.4–1.5 mm longae, glabrae, loculis 1–1.2 mm longis, cylindricis et non alatis, apice rotundatis, connectivo loculos 0.3–0.4 mm superanti. Ovarium glabrum, loculis omnibus fertilibus.

Shrub or small tree 1–6 m tall; vegetative internodes glabrous. Lamina of larger leaves 3–4 cm long, 1.5–2.2 cm wide, elliptical or slightly ovate, cuneate and often somewhat decurrent at base, strongly revolute at margin, broadly obtuse to rounded at apex, coriaceous, glabrous, the lateral veins 5–8 on each side of the midrib, obscure or prominulous above and below, the lesser veins and reticulum generally not visible; petiole 6–8 mm long, glabrous; stipules 1.5–2 mm long, free,

ovate, rounded at apex, abaxially glabrous, adaxially sericeous. Inflorescence 3–6 cm long, loosely sericeous or subtomentose, the flowers borne 1 (–2) per bract; bracts 2.2–3.2 mm long and wide, broadly ovate to subrotund, glabrous except ciliate on the margin, stiffly somewhat spreading but not reflexed or revolute, persistent; peduncle none; bracteoles like the bracts but smaller; pedicel 2.5–3 mm long, tomentose, straight in bud. Sepals all biglandular, 1.8–2 mm long beyond glands, 2–2.8 mm wide, broadly rounded, abaxially tomentose just above glands and distally glabrous, ciliate on the margin, adaxially glabrous, appressed in anthesis, the glands 2.5–3.5 mm long, decurrent on the pedicel. Petals pink, glabrous, the lateral 4 with the claw 2–2.5 mm long, the limb 3.5–4 mm long and wide; posterior petal with the claw 2.5 mm long, the limb ca 3.5 mm long and wide. Filaments 2.5 mm long, straight or slightly curved, abaxially glabrous, adaxially hirsute at base; anthers 1.4–1.5 mm long, glabrous; locules 1–1.2 mm long, cylindrical, unwinged, rounded at apex; connective exceeding locules by 0.3–0.4 mm. Ovary 1.5 mm high, glabrous, sulcate, all 3 locules fertile; styles ca 2.2 mm long. Fruit unknown.

This species is known only from the type, which is in very early anthesis. Its name honors Paul E. Berry, worthy successor to Julian Steyermark as editor of the "Flora of the Venezuelan Guayana." *Byrsonima baccae* is notable for its small, thick, strongly revolute leaves and its very short, straight pedicels. It is most like *Byrsonima steyermarkii* W. R. Anderson, another endemic of the Venezuelan tepuis known only from Cerros Jaua and Paru, slightly to the south of the Sierra Maiqualida. That species differs from *B. baccae* especially in its leaves, which have a shorter petiole and a much larger, only slightly revolute lamina that is rounded or somewhat cordate at its base. Its stipules are 3–5 mm long and it consistently bears only one flower per bract, with a pedicel 8–12 mm long that is circinate in bud. The flowers of the two species hardly differ; the anther locules are acute in *B. steyermarkii*, and the petals are white, but the latter character is to be viewed with caution, because in this group of species the petals are usually white at first turning pink with age, so apparent differences can be artifacts of the stage of flowering when the plants were collected. Another probably close relative is the widespread *Byrsonima concinna* Bentham, immediately distinguished by its anther locules, which are dorsiventrally flattened and bear narrow longitudinal wings. *Byrsonima concinna* also differs in having leaves with longer petioles and larger laminas that are not or hardly revolute, longer circinate pedicels, and sepals that are revolute in anthesis. *Byrsonima kariniana* W. R. Anderson bears some resemblance to *B. baccae* because it has similar short straight pedicels, but comparison reveals numerous differences, including initially sericeous stems, leaves, stipules, inflorescence bracts, and sepals, leaves with longer petioles and larger laminas that are only slightly revolute, stipules that are 1/2–4/5 connate, a longer extension of the anther connective, and the anterior locule of the ovary sterile.

**Byrsonima duckeana** W. R. Anderson, sp. nov.—TYPE: BRAZIL. Amazônas: Distr. Agropecuário, 90 km NNE de Manaus, Reserva 1501 (Km 41), árvore A606, 2°24'26"–2°25'31"S, 59°43'40"–59°45'50"W, 25 Jan 1992 fl, *Oliveira et al. 329* (holotype: MICH!; isotype: NY!).

Arbor 7–25 m alta, ramis hispido-tomentosis. Lamina foliorum majorum (11–) 14–27 cm longa, 6–12.5 cm lata, elliptica vel obovata, abaxialiter pertinaciter arcte brunneo-tomentosa pilis stellatis, sessilibus vel subsessilibus, minutis; petiolus 17–

33 mm longus, hispido-tomentosus vel glabrescens; stipulae 5–9 mm longae, connatae, in petiolo persistentes. Inflorescentia 10–22 cm longa, velutina, floribus singulis, bracteis 2–6 mm longis, bracteolis 1.5–3 mm longis, bracteis bracteolisque deciduis; pedicellus 8–12 mm longus (–15 mm in fructu), leviter circinatus in alabastro, decurvatus vel tortus in fructu. Flores fructusque eis *B. stipulaceae* similes.

Tree 7–25 m tall; stems initially hispid-tomentose with a mixture of long spreading basifixed or sub-basifixed hairs and a tight underlayer of minute stellate scale-like hairs, the long hairs mostly deciduous early and the stems glabrescent in subsequent seasons. Lamina of larger leaves on sexually mature trees (11–) 14–27 cm long, 6–12.5 cm wide (up to 45 × 15 cm on immature trees), elliptical or obovate, gradually tapered to cuneate at base, slightly revolute at margin, rounded, obtuse, acute, or abruptly short-acuminate at apex, initially hispid-tomentose on both sides but at maturity thinly stellate-tomentose to glabrate above and persistently brown-tomentose below with a dense, tight covering of minute (ca 0.1 mm in diameter), sessile or subsessile, stellate hairs plus often an admixture of long basifixed hairs on the midrib, the midrib and lateral veins very prominent below, the scalariform tertiary veins moderately prominent below; petiole 17–33 mm long, hispid-tomentose to glabrate; stipules 5–9 mm long, amplexicaulous, abaxially hispid-tomentose to glabrescent, adaxially glabrous or tomentose distally, completely and smoothly connate, rounded or obtuse at apex, lineate with many fine parallel veins, persistent on the petiole and falling with the leaf. Inflorescence 10–22 cm long, velutinous, the flowers borne 1 per bract; bracts 2–6 mm long, ca 2 mm wide, ovate to narrowly triangular, straight or somewhat reflexed but not revolute, abaxially tomentose, adaxially tomentose to glabrescent, deciduous before or during anthesis, well before enlargement of the fruits; peduncle 0–1 mm long (–2 mm in fruit); bracteoles like the bracts but shorter, 1.5–3 mm long, ca 2 mm wide, deciduous; pedicel 8–12 mm long (–15 mm in fruit), velutinous, slightly circinate in bud, decurved or twisted in old flowers and fruits. Sepals all biglandular or all eglandular, ca 3 mm long, 2–2.4 mm wide, lingulate, rounded at the apex, already revolute in bud and strongly revolute in anthesis, stellate-tomentose on both sides, accrescent and somewhat auriculate in fruit, the glands 2–3 mm long. Petals yellow, glabrous, erose to subentire, the lateral 4 with the claw 2.5–3 mm long, the limb 4.5–6 mm long, 6–7 mm wide; posterior petal with the claw 2.7–3 mm long, very thick, the limb 2.5–3 mm long, 3–4 mm wide, crumpled, strongly reflexed. Filaments 1.5–2 mm long, basally connate, abaxially glabrous or nearly so, adaxially short-hirsute at the base; anthers 2.2–3.2 mm long, heterogeneous in the same flower, the locules linear, 1.7–2.6 mm long, loosely sericeous on both sides, free at the apex, the connective exceeding the locules by 0.4–1.1 mm, rounded or obtuse and often somewhat reflexed at the apex. Ovary conical, 1.5–2 mm high, densely tomentose, all 3 locules fertile; styles 3.2–3.5 mm long, basally pilose. Fruit globose, 11–18 mm in diameter (dried), with a short apical beak ca 1–2 mm long formed by the thickened bases of the persistent styles, orange-yellow, densely stellate-pilose when immature, with some hairs persisting even at maturity.

Additional Specimens Examined. **Brazil**: Amazônas: Reserva Florestal Ducke, Km 26 on Manaus–Itacoatiara Hwy, *Anderson 13767* (MICH); Mpio. Pres. Figueredo, Rio Uatumã, 1–2°S, 59–60°W, *Cid Ferreira et al. 6714* (MICH); Mpio. Manaus, 80 km N of Manaus, *Dick 207* (MICH); Manaus, Colonia Campos Salles, *Ducke s.n.* (MG 11149); [Mpio. Manaus], Distr. Agropecuário, *Freitas da Silva et al. 558* (MICH); Manaus, R. F. Ducke, *Freitas & Rodrigues 1046* (NY); Mpio. Manaus, Distr. Agropecuário, *Martins et al. 105* (NY) & *189* (MICH), *Mori et al. 20556* (MICH); Manaus, Reserva Ducke, *Mota & Coêlho 68* (MO); Reserva Florestal Ducke, *Nascimento & Damião s.n.* (INPA 66283);

Mpio. Manaus, Distr. Agropecuário, *Nee 42362* (MICH, MO), *42383* (MICH, NY), *43021* & *43022* (both MICH), *Pacheco et al. 165* (MICH), *Palheta 1522* (MICH); estrada Manaus–Itacoatiara, Km 120, *Rodrigues 8676* (CTES, INPA, MG, MO); Manaus, R. F. Ducke, *Rodrigues & Freitas da Silva 9111* (NY); Rio Negro, Rio Jauaperi, Estirão Tacuera, *Santos 63* (MICH, MO); Mpio. Manaus, Distr. Agropecuário, 90 km N of Manaus, *Silva 598* & *2430* (both MICH).—PARÁ: Rio Cupari, Capoeirinha, *Black 47-2095* (IAN); Rio Cupari, Ingatubinha, *Black 47-2128* (IAN); Mpio. Oriximiná, 14–18 km de Cachoeira Porteira na BR 163, 0°57'S, 57°W, *Cid Ferreira 7635* (MICH) & *9729* (MO).

I am naming this species in honor of the great Brazilian botanist Adolpho Ducke (1876–1959), who collected it in the vicinity of Manaus. It grows at elevations of 50–125 m in non-flooded forests (*mata de terra firme*) or in secondary thickets derived from such forests, where it has been collected with flowers from November to January and with fruits from February to August. As in many other species of *Byrsonima*, in *B. duckeana* the sepals may be all biglandular or all eglandular. Both conditions probably occur in the same populations; certainly both forms have been collected in the vicinity of Manaus. I consider this character to have no taxonomic significance in *Byrsonima*, but for the record I should note that the flowers of the type have glandular sepals. *Byrsonima duckeana* is closely related to *B. stipulacea* Adr. Juss., which is common in eastern Amazonia from Bolívar and Delta Amacuro in Venezuela through the Guianas, Roraima, eastern Pará, and the Atlantic lowlands of Brazil south to Espírito Santo. The two species are identical in most morphological features, but they are easily distinguished on the bases of their leaf hairs and stipules. In both species most hairs are stellate (one-celled, but with several radiating branches instead of the two found in most Malpighiaceae), but in *B. stipulacea* many of the stellate hairs are borne well above the epidermis on a long stalk, while in *B. duckeana* the hairs are nearly or quite sessile. The cumulative effects of these two hair-types are strikingly different, the vesture appearing much tighter and smoother in *B. duckeana* than in *B. stipulacea*. Moreover, in *B. stipulacea* the stipules are deciduous before the leaves and independently of them; in *B. duckeana* the stipules are persistent on the petioles and fall with the leaves, as in most species of *Byrsonima*. Another member of this complex is *Byrsonima fanshawei* W. R. Anderson, a rare small tree of savannas in Guyana. That species has smaller leaves with shorter petioles and stipules. More importantly, its leaf-hairs are dramatically different. They are sessile or subsessile as in *B. duckeana*, but very irregularly 2–5-branched, with the relatively long branches raised and twisted, producing a loose tomentum; the hairs are typically 0.2–0.4 mm long or longer in their longest dimension. In contrast, in *B. duckeana* the hairs are minute (0.1–0.15 mm or less in diameter) and truly stellate, with ca 7–15 short, stiff, radiating branches. See also the discussion below under *B. krukoffii*.

**Byrsonima herrerae** W. R. Anderson, sp. nov.—TYPE: COSTA RICA. Limón: Cantón de Talamanca, Alto Urén, subiendo a Cerro Chun siguiendo un antiguo camino de Quebrada Chaho a Alto Lari, 9°24'10"N, 83°20'00"W, 800 m, 24 Jul 1989 fl, *Herrera 3333* (holotype: MICH!).

Arbor 12–20 m alta, ramis vegetativis sericeis vel glabrescentibus. Lamina foliorum majorum 7.5–13 cm longa, 3.3–6 cm lata, apice breviacuminata, subtus pertinaciter sericea vel demum glabrescens, tenuis reticulo subtus manifesto; petiolus 15–32 mm longus; stipulae 1.5–3 mm longae, omnino connatae, abaxialiter sericeae. Inflorescentia sericea, floribus singulis, bracteis bracteolisque 0.5–1 mm longis latisque, post maturitate fructus persistentibus; pedicellus 5–6 mm longus

(usque ad 11 mm in fructu), circinatus in alabastro, rectus in fructu. Sepala per anthesin appressa. Petala rosea vel primum alba demum rosea. Filamenta 1.4–1.6 mm longa; antherae 1.2–1.7 mm longae, glabrae, loculis 1–1.5 mm longis, cylindricis, apice rotundatis vel mucronulatis, connectivo loculos aequanti in stamine petalo postico opposito, cetera 0.3–0.6 mm superanti. Ovarium glabrum, loculis omnibus fertilibus.

Tree 12–20 m tall; stems sericeous to glabrescent. Lamina of larger leaves 7.5–13 cm long, 3.3–6 cm wide, elliptical or somewhat obovate, cuneate at base, flat at margin, mostly abruptly short-acuminate at apex, sparsely sericeous to glabrate above, thinly but persistently sericeous below or eventually glabrescent, thin, the lateral veins and reticulum visible and prominent on both sides but especially below; petiole 15–32 mm long, sericeous to glabrate; stipules 1.5–3 mm long, completely and smoothly connate, the pair ovate or triangular, obtuse or acute at apex, abaxially sericeous, adaxially glabrous. Inflorescence 7–14 cm long, sericeous, the flowers borne 1 per bract; bracts and bracteoles 0.5–1 mm long and wide, triangular to broadly ovate, persistent past maturity of the fruit; peduncle none; pedicel 5–6 mm long in flower, up to 11 mm long in fruit, loosely sericeous, circinate in bud, straight in fruit. Sepals all biglandular, 1.5–1.7 mm long beyond glands, 1.5–2 mm wide, broadly triangular with obtuse or rounded apex, appressed in anthesis, enlarging and becoming somewhat auriculate in fruit, abaxially sericeous, adaxially glabrous; glands white or pink, 1.5–2 mm long. Petals pink or white turning pink, glabrous, the lateral 4 with the claw 1.5–2 mm long, the limb 3.5–4 mm long, 3.5–5 mm wide; posterior petal with the claw 2 mm long, the limb 3 mm long and wide. Filaments 1.4–1.6 mm long, straight, abaxially glabrous, adaxially hirsute at base; anthers 1.2–1.7 mm long, glabrous; locules 1–1.5 mm long, cylindrical, detached at apex and rounded or (in the same flower) minutely mucronate; connective exceeding locules by 0.3–0.6 mm with the extension bulbous or tapered, straight or recurved, except for the stamen opposite the posterior petal, in which the short connective is equalled by the locule tips. Ovary 1 mm high, glabrous, conical, all 3 locules fertile; styles 2.5 mm long. Fruit 7.5–8.5 mm in diameter (dried, immature), 8.5 mm high, ovoid and slightly peaked at apex, glabrous.

Additional Specimens Examined. **Costa Rica**. Limón: Cantón de Talamanca, Bratsi, Alto Lari, entre Río Dapari y Río Lari, 9°25'50"N, 83°03'20"W, 450 m, Mar fl, *Aguilar 1032* (MICH); Cantón de Limón, El Progreso, 9°47'19"N, 83°08'30"W, 1200 m, bosque transicional, Apr fr, *Herrera 2709* (MICH). **Panama**. Chiriquí, vicinity of Fortuna Dam, 8°45'N, 82°15'W: valley S of lake, 1200–1300 m, Dec imm fr, *McPherson & Aranda 10119* (MICH); trail from road across Río Hornito, 1100–1250 m, Aug imm fl, *McPherson 12834* (MICH) & *12843* (MO).

The epithet of this species honors Gerardo Herrera, who has collected the type and many other valuable records of Costa Rican plants. It is known only from the above-cited localities in southeastern Costa Rica and western Panama. *Byrsonima herrerae* is most closely related to *B. trinitensis* Adr. Juss. of the Lesser Antilles and *B. karstenii* W. R. Anderson of northern Venezuela. Both of those species have the leaf lamina thicker, mostly obtuse or rounded at the apex, and soon nearly or quite glabrate, and the petiole shorter. Their pedicels are decurved in fruit and their flowers are larger, with longer filaments, anthers, and extensions of the anther connectives. *Byrsonima trinitensis* is further distinguished by its sepals, which are revolute at the apex in anthesis, and in *B. karstenii* the bracts and bracteoles are longer than those of *B. herrerae* and the inflorescence and

pedicels are tomentose. The only other pink/white-flowered species of *Byrsonima* in Panama is *B. dressleri* W. Lewis, which has glabrous leaves with a thick lamina in which the reticulum is obscure, petioles only 3–8 mm long, glabrous (or immediately glabrate) stems, bracts that are 1.5–2 mm long, and the pedicels straight in bud and decurved in fruit. No other species with pink or white flowers are known to occur in Costa Rica.

**Byrsonima krukoffii** W. R. Anderson, sp. nov.—TYPE: BRAZIL. Rondônia ("Matto Grosso"): near Tabajara ("Tabajaza"), upper Machado River region, Nov–Dec 1931 fl, *Krukoff 1360* (holotype: MICH!; isotypes: BM!, G!, K (2 sheets)!, MO!, NY!, P!).

*Byrsonimae stipulaceae* Adr. Juss. affinis sed pilis foliaribus basifixis vel sub-basifixis vel V-formibus, nunquam stellatis, differt.

Shrub or tree 8–30 m tall; stems velutinous with a mixture of short hairs up to 1 mm long and long, straight, basifixed, spreading hairs up to 3 mm long, eventually (usually in subsequent seasons) glabrescent. Lamina of larger leaves (11–) 13–27.5 cm long, 6–13 cm wide, elliptical or obovate, cuneate at base, usually slightly revolute at margin, rounded, obtuse, acute, or occasionally abruptly short-acuminate at apex, initially velutinous on both sides with many erect, straight or somewhat sinuous, basifixed or sub-basifixed hairs 1–3 mm long and usually, proximally on the midrib, many short basifixed or sub-basifixed or V-shaped hairs up to 1 mm long, some hairs lost, especially adaxially, at maturity but never completely glabrate, the hairs especially persistent on midrib, the midrib, lateral veins, and ± scalariform tertiary veins prominent below; petiole (18–) 20–30 mm long, velutinous like stems; stipules 13–25 mm long, amplexicaulous, abaxially appressed-velutinous, adaxially glabrous, completely and smoothly connate, rounded or obtuse at apex, lineate with many fine parallel veins, deciduous independently of and well before the leaf. Inflorescence 9–21 cm long, velutinous, the flowers borne 1 per bract; bracts (3–) 4–10 mm long, 1.5–2.8 mm wide, narrowly elliptical or triangular to almost linear, straight or spreading but not revolute from the apex, tomentose on both sides, more densely so abaxially, deciduous before or during anthesis, almost always well before enlargement of the fruits; peduncle 0–1 mm long; bracteoles like the bracts but shorter and relatively broader, 2–4 (–5) mm long, 1–3 mm wide, deciduous; pedicel 10–14 mm long (–16 mm in fruit), velutinous, not or slightly circinate in bud, decurved or twisted in old flowers and fruits. Sepals all biglandular or all eglandular, 2.5–3.5 mm long, 2 mm wide, lingulate, rounded at the apex, already revolute in bud and strongly revolute in anthesis, tomentose on both sides, accrescent and somewhat auriculate in fruit, the glands 2.5–3 mm long. Petals yellow, glabrous, denticulate or erose to subentire, the lateral 4 with the claw 3–4 mm long, the limb 5.5–7 mm long, 6–10 mm wide; posterior petal with the claw 3.5–4 mm long, thick, the limb 3.5 mm long, 3.5–5 mm wide, crumpled, strongly reflexed. Filaments ca 2 mm long, basally connate, abaxially glabrous, adaxially short-hirsute at the base; anthers 2.5–4 mm long, heterogeneous in the same flower, the locules linear, 1.7–3 mm long, loosely sericeous on both sides, free at the apex, the connective exceeding the locules by 0.7–1.4 mm, rounded or obtuse and often reflexed at the apex. Ovary conical, 1–2 mm high, densely tomentose, all 3 locules fertile; styles 3.5–5 mm long, glabrous. Immature fruit ovoid, 13–15 mm high and 9 mm in diameter (dried), tomentose to glabrate; mature fruit unknown.

ADDITIONAL SPECIMENS EXAMINED. **Brazil**. ACRE: Mpio. Mancio Lima, road from Isac, 7 km from the city, 7°37'S, 72°55'W, *Cid Ferreira 10918* (MICH); Cruzeiro do Sul, near airport, *Marinho 208* (MICH), *Monteiro & Damião 436* (INPA), *Rosa 753* (MICH).—AMAZÔNAS: Mpio. São Paulo de Olivença, Rio Jandiatuba, *Cid et al. 8583* (MICH); Tocantins, Solimões, *J. G. Kuhlmann 1258* (MICH); Mpio. Coari, Rio Coari, *Magnago et al. s.n.* (INPA 58047).—PARÁ: Cuiabá–Santarém Highway, BR 163, Km 1225, *Prance 25623* (MICH). **Peru**. HUÁNUCO: Leoncio Prado, 640 m, *Gutiérrez 33* (K). **Ecuador**. PASTAZA: Curaray, ridge NE of Destacamento, 1°21'S, 76°56'W, 250 m, *Holm-Nielsen et al. 21964* (AAU); 20 km S of Curaray, 1°32'S, 76°51'W, 300 m, *Zak & Espinoza 4980* (MICH).

Collected in wet tropical forest on "terra firme," with flowers from November to March and fruits from January to May; central and western Amazonia. The epithet honors the collector of the type, Boris A. Krukoff (1898–1983).

*Byrsonima krukoffii*, like *B. duckeana* (described above), is a member of the *B. stipulacea* complex. It shares with *B. stipulacea* the synapomorphy of deciduous stipules, which *B. duckeana* lacks, but whereas *B. stipulacea* and *B. duckeana* have many of the leaf hairs stellate, in *B. krukoffii* the hairs on the leaves are mostly basifixed or sub-basifixed; I have found no stellate hairs on these plants. *Byrsonima krukoffii* seems to be the western and southwestern analogue of *B. stipulacea*, which is found mostly east and north of where the new species has been collected. The type of *B. krukoffii* has glandular sepals.

**Gaudichaudia albida** Schlecht. & Cham., Linnaea 5: 217. 1830.—TYPE: MEXICO. Veracruz: Hacienda de la Laguna, Sep 1828 fl, *Schiede & Deppe* (lectotype, here designated: HAL 074279, assigned the number "445" by Chamisso, photocopy at MICH!; isolectotypes: GOET!, P-JU 11745+B!).

The authors cited two collections in the protologue, so it is necessary to select one as the lectotype. The collection by Schiede & Deppe is surely the one that served as the basis for the description in the protologue. Schiede's label bears the number 591.

**Heteropterys fruticosa** W. R. Anderson, sp. nov.—TYPE: BRAZIL. Pará: Alto Tapajós, region of Missão Velha, a Mundurukú village ca 2 km N of the Rio Cururú, 7°45'S, 57°20'W, 200 m, sandy floodplain between the river and the village, with scattered shrubs and small trees, partly inundated with runoff water at this season, 13 Feb 1974 fl, *Anderson 10923* (holotype: IAN!; isotype: NY!). Fig. 3, a–g.

*Heteropterydi nervosae* Adr. Juss. affinis sed habitu fruticoso et foliis appressis petiolis 1–2 (–3) mm longis differt.

Low shrub to 1 m tall, with erect stems from a woody base, the stems glabrous or initially very sparsely sericeous and soon glabrate. Leaves opposite, whorled, or alternate on the same stems, ± appressed; lamina of larger leaves 6.5–10.5 cm long, 2.4–4.7 cm wide, elliptical or somewhat ovate or obovate, broadly cuneate, rounded, or slightly cordate at base, acute or obtuse to rounded and very abruptly short-acuminate at apex, glabrous, with 2 large impressed glands abaxially at base and usually a row of smaller glands near or somewhat inside margin, the lateral veins and reticulum ± equally prominent on both sides; petiole 1–2 (–3) mm long, glabrous or initially sparsely sericeous and soon glabrate, eglandular; stipules not found. Inflorescence an elongated, open panicle, loosely sericeous, with the flowers borne ultimately in groups 1–2 cm long, comprising typically a terminal umbel

FIG. 3. *Heteropterys fruticosa* and *H. prancei*. a–g, *H. fruticosa*: a) leafy and flowering stems, ×0.5; b) rootstock, ×0.5; c) branch of inflorescence, ×1.5; d) flower bud, ×5; e) flower with posterior petal uppermost, ×2.5; f) anther, abaxial view, ×10; g) style tip, lateral view, ×20. h–n, *H. prancei*: h) leaf and partial inflorescence, ×0.5; i) petiole showing sunken glands, ×1.5; j) flower bud, ×5; k) flower with posterior petal uppermost, ×2.5, and posterior petal enlarged, ×5; l) anther, abaxial view, ×10; m) style tip, lateral view, ×20; n) samara, ×0.75. Drawn by Karin Douthit, a, c & d from *Anderson 10923*, b & e–g from *Pires et al. 6083*, h–m from *Prance et al. 6788*, n from *Zarucchi et al. 2759*.

of 4 flowers plus another pair of flowers below but the exact numbers varying by several flowers; bracts 1–1.5 mm long, ca 0.8 mm wide, ovate or elliptical, eglandular, persistent or irregularly deciduous in old flowers; peduncle 2–4 mm long; bracteoles apical, like the bracts or slightly larger, persistent; pedicel 2.5–4.5 mm long. Sepals 2–2.5 mm long, 1.5 mm wide, narrowly ovate, revolute in anthesis, abaxially sericeous, adaxially glabrous, the anterior eglandular or rarely biglandular, the lateral 4 biglandular with the glands 0.9–1.3 mm long. Petals yellow, glabrous, the lateral 4 spreading to reflexed, with the claw 2–2.5 mm long, the limb 3–3.5 mm long, 2.5–3 mm wide, erose and eglandular at the margin; posterior petal erect, with the claw 2.5–3 mm long, the limb 3–3.5 mm long, 2.5–3 mm wide, coarsely dentate and eglandular at the margin. Stamens glabrous; filaments 2–2.5 mm long, all straight and slender, longer opposite sepals than petals, basally connate; anthers 0.5–0.9 mm long, the connective proximally dark red, distally yellow. Ovary ca 1 mm high, sericeous; styles 2–2.5 mm long, the anterior erect and straight, the posterior 2 divergent or somewhat arcuate, glabrous or proximally sericeous, dorsally truncate or short-apiculate at apex. Fully-formed fruits not seen.

Additional Specimens Examined. **Brazil**. Amazônas: Rodovia do Estanho, margem da rodovia a 12 km de Humaitá, campo, solo arenoso, branco, Sep fl, *Vieira et al. 167* (MICH).—Pará: Serra do Cachimbo, 425 m, Dec fl/imm fr, *Pires et al. 6083* (NY, UB).—Rondônia: Abunã, Madeira–Mamoré Railway, Sep fl, *Maguire et al. 56642* (NY).

This species belongs to subgenus *Parabanisteria*, which is characterized by its long, valvate sepals that completely conceal the petals in bud; in anthesis the sepals are strongly revolute, which makes the subgenus easy to recognize. *Heteropterys fruticosa* resembles *H. nervosa* Adr. Juss., a polymorphic species found throughout Amazonia. The latter differs from *H. fruticosa* in being a woody vine that climbs trees, and in having spreading leaves with petioles at least 5 mm long and usually 8 mm or longer. *Heteropterys fruticosa*, which is named for its shrubby habit, is also notable for its eglandular bracts and bracteoles.

**Heteropterys prancei** W. R. Anderson, sp. nov.—Type: Brazil. Rondônia: Rio Bananeiras at crossing of road Guajará-Mirim to Abunã, disturbed forest on terra firme, 5 Aug 1968 fl, *Prance et al. 6788* (holotype: INPA!; isotypes: MICH!, NY!). Fig. 3, h–n.

Liana lignosa, ramis sericeis demum glabratis. Lamina foliorum majorum 15–24.5 cm longa, 6–10 cm lata, sericea mox glabrata; petiolus 10–17 mm longus, 2 (–4) glandulis immersis instructus. Inflorescentia panicula ex pseudoracemis 8–50-floris constans; bracteae 1.5–3 mm longae, 1–1.5 mm latae, bracteolae 1.5–2 mm longae, 0.8–1.3 mm latae, bracteae bracteolaeque deciduae; pedunculus 2–3 mm longus; pedicellus (2–) 2.5–4.5 mm longus. Sepala apice revoluta; petala flava, glabra, petalum posticum basi limbi glanduliferum; antherae glabrae. Samara 35–42 mm longa, nuce cylindracea.

Woody liana climbing high in trees (described once as a shrub, once as a small tree), the stems initially sericeous with straight, sessile, tightly appressed hairs 0.15–0.4 mm long, soon glabrate and finely to coarsely lenticellate. Lamina of larger leaves 15–24.5 cm long, 6–10 cm wide, elliptical or widest near the apex, cuneate to nearly rounded at base, very abruptly short-acuminate at apex with acumen 3–15 mm long, initially sericeous on both sides like stem but soon gla-

brate or persistently sericeous below on midrib, with an abaxial row of small impressed glands at or somewhat inside margin and at ± regular intervals from base to apex, and sometimes with 2 larger glands at very base, the reticulum concolorous or whitish and raised ± equally on both sides; petiole 10–17 mm long, sericeous like stems to glabrate, often horizontally fissured in age, bearing 2 (–4) glands usually sunk in pits; stipules ca 0.2 mm long, triangular, borne on stem beside petiole, seldom evident, probably caducous. Inflorescence a panicle, loosely sericeous, with the flowers borne in pseudoracemes (1–) 3–10 cm long and containing 8–50 or more flowers; bracts 1.5–3 mm long, 1–1.5 mm wide, ovate or elliptical, eglandular or bearing 1–several small marginal glands on each side, deciduous during anthesis or at latest before maturity of the fruit; peduncle 2–3 mm long; bracteoles apical or slightly subapical, 1.5–2 mm long, 0.8–1.3 mm wide, otherwise like the bracts; pedicel (2–) 2.5–4.5 mm long. Sepals all eglandular or the lateral 4 biglandular, 2.5–3 mm long, 1.5–1.7 mm wide, narrowly ovate, revolute in anthesis, abaxially sericeous, adaxially glabrous, the glands when present 1.5–2 mm long. Petals yellow, glabrous, the lateral 4 spreading, with the claw 1.7–2.3 (–2.8) mm long, the limb 3.5–4.5 mm long, 3–3.5 mm wide, erose and eglandular at the margin or occasionally bearing 1 tiny gland near base; posterior petal erect (?), with the claw 2–3 mm long, the limb 2.5–3 mm long, 2–2.5 mm wide, erose and usually bearing several small marginal glands near base. Stamens glabrous; filaments 1.5–2.8 mm long, all straight and slender, longest opposite the anterior and anterior-lateral sepals, basally connate; anthers 0.7–1 mm long, the connective red to black. Ovary ca 1 mm high, sericeous; styles 2–2.5 mm long, divergent or somewhat arcuate and the posterior 2 rotated so that all 3 stigmas face toward the posterior petal, glabrous or proximally sericeous, dorsally short-hooked at apex, the hook 0.1–0.2 mm long. Samara 35–42 mm long; dorsal wing 28–36 mm long, 11–16 mm wide, the abaxial edge curved or bent upward ± abruptly; nut 6–10 mm long, 3–5 mm high, cylindroidal.

Additional Specimens Examined. **Brazil**. Acre: Basin of Rio Purus, near mouth of Rio Macauhan (tributary of Rio Yaco), 9°20'S, 69°W, *Krukoff 5750* (MICH, NY).—Amazônas: Basin of Rio Madeira, Mpio. Humaitá, near Livramento, on Rio Livramento, *Krukoff 7012* (MICH, NY).—Mato Grosso: Rio Aripuanã, bay near Igarapezinho, 10°12'S, 59°21'W, *Berg et al. P18428* (INPA, MICH); Mpio. Alta Floresta, 3 km N of road from Alta Floresta to Rio Apiacá (MT 208), 44.5 km E of Rio Apiacá, 9°56'S, 56°38'W, *Thomas et al. 4094* (MICH).—Rondônia: Bananeiras to Abunã, along Madeira–Mamoré Railway, *Maguire et al. 56622* (MICH, NY); 18 km E of Mineração Campo Novo (100 km SW of Ariquemes), 10°34'S, 63°28'W, *Zarucchi et al. 2759* (MICH). **Colombia**. Amazonas: Amazon River, Leticia, *Schultes 6193A* (NY, US). **Peru**. Loreto, Maynas: Río Itaya near Palo Seco, 40 river km above Iquitos, *Gentry et al. 18478* (MICH); Quebrada Tamshiyacu E of Tamshiyacu below Serafin Filomeno, 4°10'S, 72°50'W, *Gentry et al. 25827* (MICH); Indiana, Explorama Reserve, 3°28'S, 72°50'W, *Vásquez & Jaramillo 13563* (MICH).

Collected in forests on "terra firme" or on seasonally inundated land, at elevations of 100–130 m, with flowers in March, August, and September, and with fruits in October. I name this species in honor of Ghillean T. Prance, one of the most important collectors ever to work in Brazilian Amazonia.

*Heteropterys prancei* is another member of subgenus *Parabanisteria*. It is especially notable for the large leaves, the petiole glands sunk in pits, the deciduous bracts and bracteoles, and the posterior (flag) petal with marginal glands at base. It most resembles *H. mathewsana* Adr. Juss., another large-leaved species of western Amazonia, which is immediately distinguished from *H. prancei* by its sessile pedicels. *Heteropterys mathewsana* also has bracts and (especially) bracteoles that

are narrower relative to their length, and the petals are eglandular and (at least sometimes) abaxially sericeous. As in most species of this subgenus, in *H. prancei* the lateral sepals may bear abaxial glands or lack them. I consider that character to have no taxonomic significance in this group, but for the record I should note that in the type collection the sepals are all eglandular.

**Heteropterys rudasii** W. R. Anderson, sp. nov.—TYPE: COLOMBIA. Amazonas: Mpio. Leticia, Corregimiento de Tarapacá, Parque Nacional Natural Amacayacu, Río Cotuhé entre la Cabaña Lorena (Inderena) y Caña Brava, en el margen izquierdo del río, 03°01'S, 70°02'W, 100 m, 20 Jun 1991 fl, *Rudas et al. 2221* (holotype: COL, photocopy MICH!; isotype: MICH!).

*Heteropterydi macradenae* (DC.) W. R. Anderson affinis sed pilis foliaribus 0.5 mm longis, sessilibus vel brevistipitatis, rectis vel tortis differt.

Woody vine, the stems initially loosely subsericeous to subvelutinous with sessile or short-stalked hairs, some straight and appressed, others more or less twisted and raised, becoming glabrate and coarsely lenticellate in age. Lamina of larger leaves 8–12.8 cm long, 3–6 cm wide, elliptical, broadly cuneate to rounded at base, abruptly short-acuminate at apex, initially loosely subsericeous to tomentose on both sides with hairs ca 0.5 mm long, sessile or short-stalked, straight to twisted, glabrate in age, with an abaxial inframarginal row of several very small impressed glands in the distal half, the reticulum not white but visible and raised on both sides, equally so or moreso below than above; petiole 4–5 mm long, loosely subsericeous or tomentose to eventually glabrate, eglandular; stipules ca 0.3 mm long, triangular, borne on stem beside petiole. Inflorescence a panicle, with the flowers borne in pseudoracemes 3–6 cm long and containing 6–14 flowers, tomentose-sericeous or subvelutinous; bracts 2–3.5 mm long, 1.5–2 mm wide, ovate or elliptical, mostly bearing 1–several small marginal glands on each side near middle, persistent; peduncle 2–3.5 mm long; bracteoles apical, 1.5–2 mm long, 1–1.2 mm wide, otherwise like the bracts; pedicel 2.4–2.9 mm long. Sepals eglandular, 3 mm long, 1.5–1.7 mm wide, narrowly ovate, strongly revolute in anthesis, abaxially tomentose, adaxially glabrous. Petals yellow, glabrous, the lateral 4 spreading, with the claw ca 2.5 mm long, the limb 3.5–4.5 mm long, 2.5–3.5 mm wide, erose and eglandular at the margin; posterior petal erect, with the claw 2.2 mm long, the limb 3 mm long, 2.5 mm wide, erose and eglandular at the margin. Filaments glabrous, 2–3.5 mm long, short and slender opposite anterior-lateral and posterior petals, long and slender opposite sepals, longest, thickest, and strongly bowed opposite posterior-lateral petals; anthers 0.8–1 mm long, glabrous (? or sparsely tomentose), the connective dark red. Ovary ca 1 mm high, sericeous; styles ca 2.8 mm long, arcuate, glabrous, dorsally hooked at apex, the hook ca 0.3 mm long. Fruit unknown.

This species is named for Agustín Rudas, collector of the type and only known collection. In most of its characters it fits into *Heteropterys macradena* (DC.) W. R. Anderson *sens. lat.*, but its peculiar leaf hairs make it distinctive. In *H. macradena* the hairs are very short, quite sessile and straight, and very strongly appressed. In *H. rudasii* the hairs are relatively long, some of them are stalked, and many are more or less twisted and raised from the surface of the lamina. I cannot recall seeing hairs like that in any other species of subgenus *Parabanisteria*, so although I hesitate to describe yet another slightly different species in this most difficult complex, I see no alternative; with those hairs *Rudas et al. 2221* would be most

anomalous in *H. macradena*. Note that the material available to me is rather young, so I cannot be certain that the bracts and bracteoles persist in fruit; that important character-state requires confirmation when older specimens are collected.

**Malpighia davilae** W. R. Anderson, sp. nov.—TYPE: MEXICO. Oaxaca: Distr. Teotitlán, 2 km al O de San Gabriel Casa Blanca, 920 m, selva baja caducifolia, 1 Jul 1987 fl, *Salinas T. 4173* (holotype: MICH!; isotype: MEXU!).

Frutex vel arbor parva 1–3 m alta, internodiis vegetativis primo tomentosis mox vel demum glabrescentibus laevibus vel minute papillosis. Lamina foliorum majorum 2–6.5 cm longa, 1–4 cm lata, elliptica vel paene orbicularis, abaxialiter plus minusve pertinaciter tomentosa et usque ad 12 mm supra basim inter costam et marginem glandulifera. Inflorescentia axillaris, stipitata stipite 3–18 mm longo, umbella (2–) 3–4-flora vel corymbus 6-florus, bracteis 0.5–1 mm longis, pedunculo florifero 3–7.5 (–11) mm longo, bracteolis 0.4–0.5 mm longis, pedicello 3.5–6 (–14) mm longo. Petala lateralia erosa vel dentata, petalum posticum fimbriatum. Styli 2–2.5 mm longi, graciles et recti vel parum arcuati, apice in angulo interno stigmatici, abaxialiter minute apiculati. Fructus siccatus 13–15 mm latus, ca 10 mm altus.

Shrub or small tree 1–3 m tall; vegetative internodes initially densely tomentose, soon or eventually glabrescent, the hairs when falling leaving the epidermis smooth or minutely papillose, not covered with prominent peglike hair-bases. Lamina of larger leaves 2–6.5 cm long, 1–4 cm wide, elliptical to nearly orbicular, broadly cuneate to rounded at base, obtuse to rounded or emarginate and often apiculate at apex, bearing 1 (–2) small glands abaxially on each side of midrib, between midrib and margin, up to 12 mm above base, adaxially tomentose to often glabrate at maturity, abaxially ± persistently tomentose or appressed-tomentose with the hairs sinuous to strongly twisted, or sometimes those near the margins straight and appressed but never bristles dramatically stouter than hairs on the midrib; petiole 1.7–2.5 (–3.5) mm long, tomentose to eventually glabrescent; stipules distinct, interpetiolar, 0.5–1.4 mm long, narrowly triangular, persistent or eventually deciduous. Inflorescence axillary and usually unbranched (rarely ternate), with a slender stalk 3–18 mm long, persistently tomentose, bearing an umbel of (2–) 3–4 flowers or a corymb of 6 flowers; bracts 0.5–1 mm long, triangular; peduncle 3–7.5 (–11) mm long, persistently tomentose; bracteoles 0.4–0.9 mm long, triangular or rounded at apex; pedicel 3.5–6 (–14) mm long, sericeous to glabrate. Sepals ca 2.5 mm long, 1–1.5 mm long beyond glands, 0.8–1 mm wide, ovate or triangular, abaxially densely sericeous or appressed-tomentose, adaxially glabrous, bearing 10 glands 1.5–2.3 mm long, the glands smallest on the anterior sepal. Petals pink, glabrous or sparsely sericeous abaxially on the midrib, abaxially slightly carinate near base of limb with the keel decurrent onto claw; lateral petals with the claw ca 2 mm long, the limb ca 3 mm long, 3.5 mm wide, rhomboid, erose or dentate; posterior petal similar to lateral petals but with the claw stouter and longer (2.5–3 mm long) and the limb ca 4 mm long and wide, fimbriate. Stamens glabrous; filaments 2–2.5 (–3) mm long, nearly straight, ca 1/2 connate, alternately longer opposite sepals and shorter opposite petals, all slender; anthers 1–1.2 mm long, subequal. Gynoecium glabrous; ovary 1.2–1.5 mm high, the carpels completely connate; styles 2–2.5 mm long, the anterior slightly shorter and slenderer than the posterior 2, slender and straight or slightly bowed, diverging in age, stigmatic on the internal angle, the apex dorsally minutely apiculate, the

apiculum more evident in the posterior 2 than in the anterior. Fruit red (or orangish?) and glabrous at maturity, 13–15 mm wide and ca 10 mm high when dried, the pyrenes held in a common flesh at maturity; pyrene with low but well-defined dorsal and lateral ribs, connected by several ribs or outgrowths at right angles to them.

Additional Specimens Examined. **Mexico**. Oaxaca: 1 km al SE de San Martín Toxpalan, *Chiang C. 2383* (XAL); 3 km adelante de Tomellín, rumbo a V. Trujano, 17°46'N, 96°57'W, *Chiang C. et al. F-2501* (MEXU); Distr. Teotitlán, 2 km al O de San Gabriel Casablanca, camino a Axuxco, *García 3449* (MEXU, MICH); 9 km al NE de Cuicatlán, rumbo a Concepción Pápalo, *González Medrano et al. F-1717* (MEXU, MICH); Barranca del Río Chico, Cuicatlán, *Miranda 4602* (MEXU); Mpio. Cuicatlán, 8 km al N de Cuicatlán, rumbo a San Pedro Jocotipac, *Sánchez-Ken 216* (MEXU); Mpio. Cuicatlán, 6 km del entronque de la brecha a San Pedro Jocotipac con la carretera Tehuacán–Cuicatlán, *Tenorio L. 17919* (MEXU, MICH). Puebla: Coxcatlán, Tehuacán, *Boege 796* (MEXU); Mpio. Coxcatlán, Rancho El Aguaje, ca 4 km al S de la cabecera municipal de Coxcatlán, 18°14'N, 97°09'W, *Valiente B. 143* (MEXU).

Endemic to the *selva baja caducifolia* of the Tehuacán-Cuicatlán Valley of Puebla and Oaxaca, at elevations of 650–1220 m, collected with flowers from late May to late September and with fruits from June to late October. I am delighted to name this species in honor of my friend and collaborator, Patricia D. Dávila Aranda, in recognition of her dedicated industry in support of the project to prepare and publish the *Flora del Valle de Tehuacán-Cuicatlán*.

Large-leaved plants of *Malpighia davilae* resemble small-leaved plants of the extremely variable species *M. mexicana* Adr. Juss., which generally has a longer inflorescence stalk, more flowers in the inflorescence, a peduncle that is short relative to the pedicel, longer bracts and bracteoles, erect straight styles, and larger fruits. Small-leaved plants of *M. davilae* resemble *M. galeottiana* Adr. Juss., but that species is usually easily distinguished by the stout, straight, appressed, golden, bristlelike hairs borne abaxially on its leaves, and by the prominent peg-like bases left on its stems when the hairs fall.

Two of the collections cited above (*Chiang C. et al. F-2501* and *Sánchez-Ken 216*) are somewhat intermediate between *M. davilae* and *M. galeottiana* in having the leaf hairs relatively straight and appressed and, in *Sánchez-Ken 216*, approaching the bristles of *M. galeottiana*. Both species occur in the area of Cuicatlán, and these two collections may result from hybridization between them. Such intermediates also raise the possibility that *M. davilae* arose as the result of hybridization between *M. galeottiana* and *M. mexicana*, which also grows in the area of Cuicatlán.

Another species that resembles *Malpighia davilae* is *M. diversifolia* Brandegee, which is endemic to Baja California Sur. In *M. diversifolia* all the petals except the outermost are deeply fimbriate, at least in the proximal half, whereas only the posterior petal of *M. davilae* is fimbriate. The leaves of *M. diversifolia* are more densely and persistently hairy, and on the adaxial surface the hairs are mostly V- or Y-shaped, producing a velutinous effect. Also, the abaxial glands are borne very near the base of the lamina in *M. diversifolia*, on or just within the margin, while those of *M. davilae* are borne well above the base and farther from the margin.

**Malpighia sessilifolia** W. R. Anderson, sp. nov.—Type: Mexico. Veracruz: Mpio. Minatitlán, Cerro Blanco, 7 km al NE de Uxpanapa, 17°14'N, 94°09'W, 200 m, pendientes ligeras inferiores del lado S del cerro, selva alta perennifolia, 19 Oct 1983 fl, *Wendt et al. 4220* (holotype: MICH!; isotype: CHAPA!).

*Malpighiae romeroanae* Cuatr. affinis sed foliis latioribus basi cordatis sessilibus vel subsessilibus et floribus fructibusque majoribus differt.

Shrub or small tree 1–3 (–4) m tall; vegetative internodes thinly sericeous to soon glabrate, often flattened below nodes. Lamina of larger leaves 14–32 cm long, 6.5–13 cm wide, elliptical or slightly obovate, cordate at base, acuminate at apex, bearing 1–3 (–4) glands below between midrib and margin in the proximal half, glabrous at maturity; petiole 0–1 (–2) mm long, when developed mostly hidden by cordate base of lamina, glabrous at maturity; stipules connate in interpetiolar pairs, the pair narrowly triangular, 2–3.5 mm long, 0.7–1.5 mm wide at base, persistent or eventually deciduous. Inflorescence sparsely sericeous to glabrate, axillary and usually unbranched (very rarely ternate), 2.5–7 cm long, with a stalk 2–5 cm long and a dense pseudoraceme or interrupted corymb of 10–25 flowers; bracts 1–2 mm long, triangular; peduncle (1–) 2.5–6 mm long; bracteoles 0.7–1 mm long, triangular; pedicel 6–14 mm long, sparsely sericeous to glabrate. Sepals ca 3 mm long, 0.8–1.5 mm long beyond glands, ca 1.5 mm wide, ovate, abaxially glabrous or more commonly bearing a few appressed hairs, adaxially glabrous, bearing 6 glands 2–3.3 mm long on the 4 lateral sepals, the 2 sepals adjacent to the eglandular anterior sepal bearing only 1 gland, on the side away from the anterior sepal. Petals pink, glabrous; lateral petals spreading, abaxially prominently carinate with the keel up to 0.4 mm wide and often decurrent on claw but not reaching apex of petal, the claw 3–4 mm long, the limb 4.5–6 mm long, 3.5–6 mm wide, often asymmetrical, distally entire, proximally erose; posterior petal erect, abaxially with the midrib raised or slightly keeled proximally, the claw 4.5–5.5 mm long, thick, the limb 6–8 mm long and wide, symmetrical, coarsely dentate all around the margin. Stamens glabrous; filaments 3–5 mm long, straight or the 2 largest somewhat arcuate, connate basally, very unequal in length and thickness in the same flower, the 2 opposite the posterior-lateral petals longer and thicker than others; anthers 1.1–2 mm long, heterogeneous in the same flower, longest opposite the posterior-lateral petals. Gynoecium glabrous; ovary 1–1.5 mm high (not including the thickened style-bases), the carpels completely connate; styles 4–5 mm long, thick and bowed (the posterior 2 more strongly arcuate than the anterior) with the base especially thickened, the stigma strongly internal, the apex dorsally extended in a hook 0.3–0.5 mm long. Fruit red and glabrous at maturity, 17 mm wide and 12–13 mm high when dried, the pyrenes held in a common flesh at maturity; pyrene with a well-developed dorsal crest 1.5–2 mm wide and several prominent ribs at right angles to it, these often fusing to form an ill-defined lateral rib on each side.

Additional Specimens Examined. **Mexico**. Oaxaca: Mpio. Sta. María Chimalapa, Arroyo de la Cascada (afluente del Arroyo Chocolín), Congregación de Nicolás Bravo, 3.5 km al S de Pob. de Río Alegre, 17°10'N, 94°42'W, *Wendt et al. 4492 & 4744* (CHAPA, MICH).—Veracruz: Mpio. Jesús Carranza, Plan de Arroyos, *Castillo C. 397* (XAL); Mpio. Jesús Carranza, Km 3–5 camino a Río Alegre, 17°20'N, 94°45'W, *Dorantes 3657* (MEXU, XAL); Mpio. Hidalgotitlán, alrededores del Campamento Hnos. Cedillo, *Dorantes 3742* (MEXU); Mpio. Hidalgotitlán, camino Cedillo–La Laguna, 17°16'N, 94°37'W, *Dorantes 4154* (XAL); Mpio. Hidalgotitlán, Brecha Cedillo–A. Melgar, 17°13'N, 94°35'W, *Vázquez 1330* (MEXU, XAL); Mpio. Hidalgotitlán, Río Soloxuchil entre Hnos. Cedillo y la Escuadra, 17°16'N, 94°37'W, *Vázquez 1374* (MEXU, XAL); Mpio. Jesús Carranza, 3 km al E de Río Chalchijapa por carr. Sarabia–Cedillo, *Vázquez 1588* (MEXU, XAL).

Collected in *selva alta perennifolia* at elevations of 100–200 m, with flowers from October to December and with fruits in December and January.

*Malpighia sessilifolia* is closely related to *M. romeroana* Cuatr., which occurs

from Colombia through Central America to Oaxaca and Veracruz in eastern Mexico and has a disjunct variety (var. *nayaritensis* Vivaldi) in western Mexico (Jalisco, Nayarit, and Sinaloa). In *M. romeroana* the leaf lamina is narrower and basally cuneate to a definite petiole, the flowers are distinctly smaller in most of their parts (petals, stamens, and styles), and the fruits are smaller.

**Mascagnia discolor** W. R. Anderson, sp. nov.—TYPE: BOLIVIA. La Paz: Inquisivi Province, 19 km N of Choquetanga, 16°41'S, 67°20'W, 1800 m, matorral, 27 Nov 1991 fl, *M. Lewis 40696* (holotype: MICH!; isotypes: MO!, NY!).

Frutex 2 m altus, ramis tomentosis. Lamina foliorum majorum 7–8 cm longa, 4.7–5.8 cm lata, adaxialiter tomentosa pilis pro parte maxima brunneis, abaxialiter densissime lanata pilis pro parte maxima stramineis vel albidis; petiolus 9–14 mm longus, brunneo-tomentosus, plerumque prope apicem biglandulosus glandulis nigris, protuberantibus; stipulae ut videtur nullae. Inflorescentia pseudoracemus axillaris, 7–13 cm longus, rufo-tomentosus; bracteae per anthesin deciduae; pedunculus (2–) 3–7 mm longus; bracteolarum altera eglandulosa, altera uniglandulosa; pedicellus 1.5–3 mm longus. Petala aurea, abaxialiter laevia; stamina glabra; styli 1.5–1.8 mm longi, divergentes, apice dorsaliter apiculati.

Shrub 2 m tall, the stems tomentose with strongly twisted reddish-brown hairs, eventually glabrescent. Lamina of larger leaves 7–8 cm long, 4.7–5.8 cm wide, ovate or broadly elliptical, broadly cuneate or truncate at base, abruptly short-acuminate to rounded at apex, smooth (not rugose) above, eglandular (?), persistently tomentose above with the epidermis visible between the mostly brown, stalked, strongly twisted hairs, persistently tomentose below, the hairs mostly pale yellow to near-white except brown along veins, very fine, with a sinuous or twisted crosspiece 1–2.2 mm long raised on a stalk 0.5–1 mm long, the hairs in aggregate producing a dense woolliness that nearly or completely hides the epidermis; petiole 9–14 mm long, densely and persistently brown-tomentose, bearing (0–1–) 2 bulging black glands at apex or up to 2.5 mm below apex; stipules not found. Inflorescence an axillary pseudoraceme, unbranched, 7–13 cm long, reddish-brown-tomentose, the 15–40 flowers borne ascending to nearly horizontal and evenly distributed, not congested except for very immature buds at apex; bracts 1.5–2.5 mm long, subulate or narrowly triangular, deciduous during anthesis; peduncle (2–) 3–7 mm long, tomentose; bracteoles 1–1.7 mm long, triangular or ovate, persistent, borne at or slightly below apex of peduncle, one eglandular and the other bearing 1 large eccentric abaxial gland; pedicel 1.5–3 mm long, tomentose. Lateral 4 sepals bearing 8 glands 2.5–3 mm long, the sepals 1.5–2 mm long beyond the glands; anterior sepal eglandular but partially covered by the 2 adjacent glands; all sepals ovate or elliptical with minutely denticulate margin and rounded apex, abaxially loosely sericeous in center and glabrous toward margin, adaxially glabrous, appressed in anthesis. Petals "yellow-orange," glabrous, exposed in enlarging bud, abaxially smooth, the lateral 4 strongly reflexed in the claw, with the limb 4.5–5 mm long, 3–3.2 mm wide, obovate or elliptical, minutely denticulate, truncate or slightly hastate at the base, the claw 1.3–1.5 mm long; posterior petal hardly different, but with the claw spreading, not reflexed, and the limb spreading to reflexed. Filaments 2.5–3 mm long, slightly longer opposite sepals than petals, glabrous, connate in the basal 1 mm; anthers 1.3–1.6 mm long, glabrous, reflexed in anthesis. Ovary ca 2 mm high, densely hirsute; styles 1.5–1.8 mm long, divergent distally, with a short dorsal hook (0.1–0.2 mm long) at the apex. Fruit unknown.

The epithet of this distinctive species refers to the striking vesture of the leaves, which is brownish above and stramineous to whitish below. Even in the absence of fruits I am confident that it is a species of *Mascagnia* subgenus *Mascagnia*, belonging to the assemblage of species including *M. cordifolia* (Adr. Juss.) Griseb., *M. strigulosa* (Rusby) Nied., and *M. schunkei* W. R. Anderson. From those taxa and their relatives *Mascagnia discolor* is immediately set apart by its long twisted leaf-hairs of two colors, the raised black glands near the apex of the petiole, the lack of stipules, the deciduous bracts, the short pedicel, and the yellow petals that are abaxially smooth, not carinate.

**Tetrapterys dillonii** W. R. Anderson, sp. nov.—TYPE: PERU. Piura: Huancabamba, ca 12 km E of Canchaque on route to Huancabamba, 5°24'S, 79°36'W, 1800 m, SW-facing slopes near waterfall, 21 Jul 1991 fl, *Dillon & Sánchez V. 6291* (holotype: MICH!).

Liana lignosa, ramis tomentoso-sericeis, demum glabratis. Lamina foliorum majorum 5.5–8.5 cm longa, 3.5–4.8 cm lata, adaxialiter sericea mox vel demum glabrescens, abaxialiter dense et plus minusque pertinaciter sericea, margine prope basim pauciglandulifera; stipulae in paribus interpetiolaribus connatae, pari 1–2.5 mm longo, 0.8–1.8 mm lato. Sepala glabra vel margine et circa glandulas paucipilifera, glandulis 1.2–2.5 mm longis. Styli 1.3–1.5 mm longi, crassi.

Woody vine; stems tomentose-sericeous to eventually glabrescent, initially with an underlayer of whitish, sessile, ± tightly appressed hairs and an overlayer of stalked, spreading, often twisted hairs. Lamina of larger leaves 5.5–8.5 cm long, 3.5–4.8 cm wide, elliptical or obovate, cuneate to nearly rounded at base, obtuse to rounded and emarginate at apex, initially sericeous above with straight or sinuous ± appressed hairs but soon or eventually glabrescent and becoming glabrate in age, densely and ± persistently whitish or metallic-sericeous below with the hairs sessile, ± straight, and mostly appressed, the surface eglandular but the margin usually bearing 1–3 impressed glands on each side within 2 cm of base; petiole 6–18 mm long, sericeous or tomentose-sericeous to glabrate, eglandular; stipules connate in interpetiolar pairs, the pair 1–2.5 mm long, 0.8–1.8 mm wide, smallest in inflorescence, ovate, sparsely pilose or glabrous, proximally dark-colored and often glandular-thickened, distally light-colored and membranous. Inflorescence tomentose-sericeous like stem, cymose-paniculate with the branches terminating in an umbel (or occasionally a corymb) of 4–6 flowers; floriferous bracts 1.3–1.7 mm long, ovate, pilose to nearly glabrous, proximally often dark and glandular-thickened or biglandular, distally often light-colored and membranous, persistent; peduncle 2–7 mm long; bracteoles like bracts but slightly shorter, apical; pedicel 3.5–9 mm long. Sepals 1–1.5 mm long beyond glands, ca 1.5 mm wide, broadly rounded, glabrous except for hairs around glands and a few hairs on margin, pressed against filaments in anthesis, the anterior eglandular, the lateral 4 biglandular with the glands 1.5–2.5 mm long, obovate, the longest glands decurrent on pedicel. Petals yellow (turning reddish in age?), glabrous, obovate, truncate or slightly cordate at base, the lateral spreading to reflexed, with claw 1–1.5 mm long and limb 4–5 mm long, 2.5–3 mm wide, subentire or minutely denticulate or erose; posterior petal erect, similar to lateral petals but with the claw thicker and often longer and the limb sometimes coarsely dentate. Filaments 1.5–2.3 mm long, glabrous, 1/3–1/2 connate; anthers 1.2–1.4 mm long, glabrous, alike, the connective only slightly swollen. Ovary 1–1.5 mm high, sericeous, showing already in flower

the precursors of the 4 lateral wings; styles 1.3–1.5 mm long, glabrous, stout with the anterior slenderer than the posterior 2, divergent, truncate at apex with the stigma internal. Fruit unknown.

ADDITIONAL SPECIMEN EXAMINED. **Peru**. CAJAMARCA: Santa Cruz, ca 2.5 km ENE of Monteseco, 1700 m, Jun fl, *Santisteban C. & Guevara B. 160* (MICH).

This distinctive species is named in honor of M. O. Dillon, one of the collectors of the type and an astute student of the plant taxonomy of western Peru. *Tetrapterys dillonii* belongs to section *Tetrapterys* (called section *Lophogynixa* by Niedenzu), as defined by the stipules connate in interpetiolar pairs and the flowers borne mostly in umbels, but it differs from most members of that group in its marginal leaf glands. The usual condition in the section is for the impressed glands to be borne in the abaxial surface of the lamina between the midrib and the margin. *Tetrapterys dillonii* is also interesting for its failure to make large membranous fugacious bracts in the inflorescence one or two nodes below the umbels, and for its short stout styles. It most resembles *T. jamesonii* Turcz., another species of northwestern Peru and adjacent Ecuador, which has similar marginal leaf glands. In *T. jamesonii* the lamina is abaxially velutinous or subtomentose, with most hairs V-shaped. Another member of this complex is *T. benthamii* Tr. & Pl. of Colombia.

**Tetrapterys heterophylla** (Griseb.) W. R. Anderson, comb. nov. *Malpighia heterophylla* Griseb., Linnaea 22: 2. 1849.—TYPE: MEXICO. *Ehrenberg 624* (holotype: B†, F neg. 12833!; isotype: MEXU!).

*Tetrapterys nelsonii* Rose, Contr. U.S. Natl. Herb. 5: 143. 1897.—TYPE: MEXICO. Oaxaca: between Nopala and Mixtepec ["Mixistepec"], *Nelson 2431* (holotype: US!; isotype: NY!).

*Tetrapterys emarginata* Bartlett, Proc. Amer. Acad. Arts 43: 53. 1907.—TYPE: GUATEMALA. Zacapa: Gualán, *Deam 150* (holotype: GH!; isotypes: F!, MICH!, MO!, NY!, US!).

*Tetrapterys nummularia* Nied., Verz. Vorles. Königl. Lyceums Hosianum Braunsberg 1909/10: 38. 1909.—TYPE: MEXICO. Oaxaca: near San Bartolo Yautepec, *Seler & Seler 1699* (lectotype, here designated: GH!).

There may be, at GOET or elsewhere in Europe, an isotype of *Malpighia heterophylla* that was seen and annotated by Grisebach, and if so that would be the appropriate choice for lectotype. If no such candidate can be found, then the isotype at MEXU can be designated lectotype.

**Tetrapterys schiedeana** Schlecht. & Cham., Linnaea 5: 218. 1830.—TYPE: MEXICO. Veracruz: in sylvis prope Jalapam in arboribus scandens, Aug 1828, *Schiede & Deppe* (lectotype, here designated: HAL 074280, assigned the number "447" by Chamisso, photocopy at MICH!; isolectotypes, all "447": MO!, NY!, P-JU 11710+B!).

*Malpighia dasycarpa* J. D. Smith, Bot. Gaz. (Crawfordsville) 24: 390. 1897.—TYPE: GUATEMALA. Retalhuleu: Río Samalá, elev. 1700', Oct 1891, *Shannon 217* (lectotype, here designated: US 1362414!; isolectotype: US 210009!).

The protologue of *Tetrapterys schiedeana* cites both Jalapa and Hacienda de la Laguna for this species. Both localities are represented by syntypes in HAL, the

one from Hacienda de la Laguna being HAL 074281 (photocopy at MICH!). Schiede's label on the latter specimen bears the number 593.

When J. D. Smith published the name *Malpighia dasycarpa* he had three syntypes, two of which represented *Tetrapterys schiedeana*; the third was another species of *Tetrapterys*. Small named the latter in 1910 as *T. donnell-smithii*, its type being the third syntype of *M. dasycarpa*, a Pittier collection from San Juan del Norte, Nicaragua. That leaves *M. dasycarpa* in need of a lectotype, one that will dispose of this never-adopted name. This note should accomplish that.

## ACKNOWLEDGMENTS

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Niedenzu, F. 1928. Malpighiaceae. In *Das Pflanzenreich*, ed. A. Engler, IV. 141: 1–870. Leipzig: Wilhelm Engelmann.

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# NATURALISTS AND THEIR TRAVELS IN MEXICO: ANNOTATED BIBLIOGRAPHY AND ROSTER OF NATURAL HISTORY COLLECTORS

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## INTRODUCTION

Mexico is a country of exceptional biological diversity and as such has attracted the attention of a large number of naturalists (=field biologists) since serious scientific exploration began there in the late 1700's. In the process of trying to reconstruct the pattern of natural history exploration in Mexico, it immediately became evident that there is a considerable body of literature about naturalists and their travels in the country. Such publications are widely scattered and vary from brief obituaries to full book-length biographies and accounts of travels, observations, and collecting. The information included in these publications is useful to biologists, historians, and other interested readers in several ways. First, and perhaps foremost, knowledge of the activities of natural history collectors and their detailed itineraries is of considerable value to those who are involved in describing and cataloging biodiversity. The systematist working with material collected by others often needs to have information on itineraries of these collectors or gazetteers of collecting localities to supplement the sometimes sparse label data accompanying the specimens. Published field notes, itineraries, and narrative accounts by naturalists frequently provide valuable data about the abundance of organisms, habitats, special conditions of collection, and other pertinent facts that are not otherwise available. Furthermore, information included in travel accounts of naturalists is important in understanding the historical development of knowledge of the flora and fauna of the area. When adequately detailed, such accounts establish baselines on which environmental changes may be measured, thus providing a significant historical resource for use in analysing and preventing loss of biological diversity. Travelogues with natural history emphasis are of special value because naturalists, aside from the attention they pay to their own specialities, tend to be highly observant about the environment in general and often see and describe things overlooked or unappreciated by the casual traveler. Some of the essays of E. O. Wilson in his book *Biophilia* provide excellent examples of how the naturalist's eyes are focused not just on ants, plants, and other organisms of special interest (the "naturalist's trance" according to Wilson), but have a much larger view of the environment as a whole. Personal accounts about observing and collecting plants and animals also provide knowledge about the author and the

state of his speciality that is valuable as primary literature to historians and biographers. In perhaps a more esoteric way, natural history exploration constitutes a genre of literature that is actively sought by book collectors and others who enjoy reading about travel and adventure in exotic places. Although Mexico cannot boast of providing the inspiration for works comparable to Henry Bates's *The Naturalist on the River Amazons* or Thomas Belt's *The Naturalist in Nicaragua*, these are prime examples of how potentially mundane accounts of natural history travel can become classic adventure literature. Anyone who has attempted to obtain some of the out-of-print books and pamphlets on this subject from book dealers can attest to the fact that there is considerable competition for such items. For biologists, book collectors, readers for pleasure, and historians, the bibliography presented here is designed to serve as a guide to the rich literature on naturalists and their travels in Mexico.

The authors, whose research activities include Mexican insects (Burke) and plants (Fryxell), have also had a longtime interest in the general natural history of the country. Our personal libraries on this subject provided a substantial amount of the material on which this publication is based. Through this annotated bibliography and roster of natural history collectors in Mexico, we wish to share with others the product of our many years of searching for, reading, and collecting literature on the lives and travels of naturalists (both resident and foreign) in the country. Bibliographies covering any subject of reasonable size are more often than not woefully incomplete. We are well aware of the difficulty of compiling a useful bibliography on a subject as broad as this and with the literature as scattered as it is. Practically every paper that has been published about Mexican plants and animals contains some historical material, either as an introduction to the subject or in its citation of collectors, localities, and dates of collections. It is sometimes possible to piece together at least partial itineraries from the data on collectors and collections cited in such papers, even though providing such an itinerary was not the intention of the author. The total amount of literature on the plants and animals of Mexico is prodigious. One only has to peruse the 1,015 pages of Langman's *A Selected Guide to the Literature on the Flowering Plants of Mexico* to appreciate the immensity of the task of accumulating references on such a sizeable natural history subject. Ellen Barrett (1957, 1967), after completing two large volumes of bibliography on Baja California (including mostly subjects other than natural history), stated "If I could live many lifetimes, this work would never be finished." We are under no illusion that the 537 books, pamphlets, and journal articles annotated here constitute anywhere near a complete bibliography on naturalists and their travels in Mexico. However, the major literature and a considerable number of minor publications on all aspects of natural history are included. We believe that a state of "reasonable completeness" has been reached. It is anticipated that this bibliography will serve as a complete resource for many users as well an entry into the literature for those who wish to pursue the subject further than we have done.

Not unexpectedly, published information about the lives and travels of naturalists in Mexico, while being voluminous, is also quite uneven. Considerable detail is available on certain naturalists (e.g., Sessé and Mociño), while little or nothing is published on others. The lives and activities of some important natural history collectors in Mexico are known only from brief published accounts, often just from short obituaries. Some, like Thomas MacDougall, left a great amount of archival material, such as field notes, letters, etc. (Root 1975), which has never been adequately mined for the interesting information it must contain about MacDougall's

extensive collecting activities in southern Mexico. Although it was not our intention to search for and include unpublished archival materials here, the availability of such records should not be overlooked by those trying to obtain information on the lives and travels of naturalists. As an example of one source of such records, Stieber (1982) compiled information on unpublished field notes and their locations for "over 600" botanists, some of whom collected in Mexico.

As one can plainly see from the entries in the bibliography, botanists have been more active in writing about their travels than their counterparts in zoology. Botanists as a group appear to recognize the need for historical accounting of their activities, and some individuals, particularly Rogers McVaugh, George Lindsay, among others, have written extensively about plant collectors and their explorations in Mexico. With some notable exceptions, zoologists are not as inclined to write histories, biographies, and natural history travelogues. Regardless of these different attitudes toward history, the distinction between the two disciplines has not always been as evident in the field. Many of the natural history collectors in Mexico, especially the early ones, collected diverse groups of organisms. The botanist Thomas MacDougall collected both plants and animals, as did the zoologists Edward Goldman and Edward Nelson. Charles Orcutt was a well-known collector of both plants and mollusks. Edward Palmer was primarily a plant collector but assembled important collections of animals and ethnographical materials. Considering the fact that many of the early collectors were often generalists in regard to what they observed and collected, the specialist today interested in Mexican organisms should be aware of the literature on itineraries and other collecting activities of all naturalists. We have tried to maintain a balance in selection of literature included here so that our bibliography will serve specialists in both botany and zoology as well as those interested in natural history in its broader aspects.

## SOURCES AND METHODS

### Bibliography

Much of the material included in the present bibliography was accumulated independently by the authors over a long period of time. When we realized that we had a common interest, we combined our lists of references on the biographies and travels of naturalists in Mexico and began to expand the list to cover more completely both botanical and zoological activities. It was immediately obvious that there were many gaps in our previous unsystematic search for literature on this subject. We then began to search more carefully through bibliographies, histories, research papers, and other likely sources for important additions to the list. One particularly useful source was Langman's truly monumental work *A Selected Guide to the Literature of Flowering Plants of Mexico*, which was scanned exhaustively for botanical references pertinent to our objective. Although we hope that we have found the most important references included by Langman, there are obviously others containing some information on botanist's travels which we missed or considered marginal to our interests. Those interested in plant collectors, therefore, should consult Langman's well-indexed guide if the present bibliography does not satisfy their needs. The publications of McVaugh (1943–1991), Lindsay (1939–1988), Rzedowski (1959–1989), and Knobloch (1979, 1983) have been especially helpful for the compiled information they contain on botanists and botanical activities in Mexico. Unfortunately, there is nothing comparable to Langman's

guide for most animal groups. The extensive herpetological literature for Mexico has been compiled by Smith and Smith (1969, 1973), but we are not aware of any similar bibliographies for other groups. Other bibliographies, such as that of Barrett (1957, 1967) on Baja California, although general in coverage, contain some natural history references. Many entries in our bibliography were located through the "chain reaction" process, that is, by following cited reference leads from one publication to another.

With few exceptions, we have examined either the original publication or photocopies of all entries in the bibliography. The Sterling C. Evans Library of Texas A&M University was a major source of materials, either from the library's holdings or through interlibrary loans. The Benson Latin American Collection of the University of Texas at Austin provided access to many early publications on natural history in Mexico. We were also fortunate to be able to obtain copies of particularly scarce items published in some Mexican journals through the libraries of the Universidad Autónoma de Chapingo, Instituto Nacional de Antropología e Historia, and the Universidad Nacional Autónoma de México. The botanical library at the Smithsonian Institution and the excellent library of the Botanical Research Institute of Texas in Fort Worth also provided several items not found elsewhere. As mentioned above, our personal libraries provided a significant portion of the material cited here.

As with all bibliographies, many arbitrary decisions were made concerning what should or should not be included. No time limit was imposed as far as publication dates are concerned; we added newly published items up to the time of preparation of the final manuscript. Our primary focus was on naturalists who collected plants and/or animals in Mexico and wrote about their experiences or whose activities were subsequently chronicled by others. Some naturalists traveled in Mexico more in the role of observers of nature than as collectors of its products. We have included travel accounts produced by such observers when these provide reasonably detailed descriptions of the land and its nonhuman occupants. A second focus was on biographies of both foreign and resident naturalists. There are relatively few comprehensive biographies for individual naturalists who have worked in Mexico but, collectively, there is a considerable amount of published biographical material available for many such persons. Several useful compilations of biographies or references thereto are available, for example: Abbott (1973) for malacologists; Adler (1989) for herpetologists; Barnhart (1965), Stafleu and Cowan (1976–1988), and Knobloch (1979, 1983) for botanists; Ewan (1950) for botanists and zoologists; Mallis (1971) and Gilbert (1977) for entomologists; and Palmer et al. (1954) for ornithologists. Finally, we have searched the literature for general and regional histories of various subdisciplines of natural history in Mexico. These obviously contain a great deal of information about naturalists and their field activities and, furthermore, they provide an overall context in which to place natural history activities. Again, botany is more extensively represented than zoology by this type of literature.

## Roster of Collectors

The list of collectors in Mexico and associated references included here are intended to assist in rapid location of itineraries, collecting sites, biographies, and other pertinent information. This roster of about 600 naturalists was compiled from information in the bibliography; therefore, all can be related directly to

these publications. While at first glance the roster may appear to contain a large number of collectors of plants and animals in Mexico, it is actually only a relatively small percentage of the total number of individuals who have worked there. Knobloch (1983) listed over 3,000 persons who are known to have collected plants in Mexico and his list is surely not complete. McVaugh (1972) includes commentary on about 250 persons who collected plants in Nueva Galicia (several states in western Mexico). It should also be kept in mind that many collectors in Mexico have not written about their activities, and the specimens that they obtained may not yet have been included in published papers. Since there are no published records of their collecting activities, they are not included in our roster. In some cases accounts of their travels are included in unpublished reports to granting agencies, in field notebooks (Stieber 1982), or in some other archival form not generally available. We believe that we have attained a level of "reasonable completeness" in the roster as in the bibliography. This list will provide a basis on which others can compile a more complete coverage of the many hundreds of naturalists who have travelled and collected in Mexico. Although an attempt was made to determine the extent of the contributions of each person as a condition of inclusion on the roster, we are aware that some of those listed may have played only minor roles and other major collectors may be omitted because of lack of documentation. As with the bibliography, we made many arbitrary decisions involving who should be included on the roster. It should be especially noted that the references keyed to each individual on the roster do not necessarily represent the sum total of biographical and/or collecting information available on that person. Only references to entries in the bibliography are included in the roster. There may be other significant information available about these individuals that is not included in the bibliography, because it does not directly involve activities in Mexico; however, the references included here for each person should provide adequate entry into the literature. Furthermore, no attempt was made to identify the reference(s) containing the most extensive information about a person's life and natural history activities. The user should search all of the references when possible. We include dates of birth and death of individuals if this information is readily available. These dates allow one to place the lives and natural history activities of individuals in a historical time frame and context.

## ANNOTATED BIBLIOGRAPHY

ABBOTT, R[OBERT] TUCKER (ed.). 1973. *American Malacologists.* Falls Church, Virginia: American Malacologists, 494 pp. [A considerable amount of summarized biographical information is presented on both deceased and living mollusk collectors, many of whom collected in Mexico. This is an excellent source of information on dates of birth and/or death, education, positions held, travels, scientific interests, and publications of 500 deceased and a larger number of living collectors of mollusks.]

ADLER, KRAIG (ed.). 1989. *Contributions to the History of Herpetology.* Contr. Herpetology 5, Oxford, Ohio: Soc. Study Amphibians and Reptiles, 202 pp. [Biographies of many herpetologists, some of whom lived and/or traveled in Mexico, for example, Thomas Barbour, Alfredo Dugès, Edward H. Taylor, and Karl P. Schmidt. A list of references is included for each individual for whom there is a biographical sketch. Also includes a useful

list of authors of literature on amphibians and reptiles, with dates of birth and/or death, country of origin, and taxonomic groups studied. Complete names and dates are provided for many biologists, including some who are not generally considered as herpetologists.]

AJOFRÍN, FRANCISCO DE. 1986. *Diario del viaje a la Nueva España.* Mexico: Sec. Educ. Públ., 220 pp. [First published in 1763 as *Diario del viaje que hecimos a México* by Francisco de Ajofrín and Fermin de Olite. In the new edition the introduction and notes are provided by Heriberto Moreno García. This is a general travel account with a discussion of customs and traditions but with relatively little natural history. Langman (1964) describes it as "A simple account, written in 1763, including descriptions of plants, sometimes without names, list of fruits and list of trees." It is included here mainly because it is an early travel account and contains some botanical information.]

ALCOCER, GABRIEL V. 1899. *El herbario de Berlandier.* Anal. Inst. Méd. Nac. Méx. 4: 118–126. [Based in part on the examination of a little known book *Diario del viaje de la comisión de limites...* under the erstwhile authorship of Manuel de Mier y Terán, but in fact consisting of various segments of the diary of Jean Louis Berlandier (these not in chronological order), who accompanied the Comisión de Limites as naturalist during its travels. Alcocer proposes a speculative itinerary based on the diary and a study of Berlandier's collection numbers, and discusses the fate of Berlandier's herbarium.]

ALDEN, ROLAND H., AND JOHN D. IFFT. 1943. *Early naturalists in the far West.* Occ. Pap. Calif. Acad. Sci., No. 20, 59 pp. [Contains some information on naturalists who traveled in Mexico, although the major emphasis is on natural history travels and collections in California. Major collectors discussed are Francisco Hernández, Thaddeus Haenke, José Mociño, Luis Née, Alexander von Humboldt, William Bullock, Alexander Collie, George Tradescant Lay, Thomas Coulter, Richard Brinsley Hinds, and Karl Theodor Hartweg.]

ALEXANDER, E[DWARD] J[OHNSTON]. 1945a. *Message from Mexico.* J. New York Bot. Gard. 46: 128, 295. [Brief account of some plant collections made in Mexico.]

ALEXANDER, E[DWARD] J[OHNSTON]. 1945b. *Back from Mexican trip.* J. New York Bot. Gard. 46: 295. [Extended expedition sponsored by the New York Botanical Garden to southern Mexico, principally in the states of Oaxaca, Chiapas, and Guerrero. Some of the travels are briefly described.]

ALLEN, J[OEL] A[SAPH]. 1889. *Notes on a collection of mammals from southern Mexico, with descriptions of new species of the genera Sciurus, Tamias, and Sigmodon.* Bull. Amer. Mus. Nat. Hist. 2: 165–181. [Describes a small collection of mammals collected by Audley Buller on a journey "from Tepic across the Sierra de Nayarit and adjoining ranges of the Sierra Madre to Zacatecas, a distance of over a 1000 miles... through one of the most inaccessible and least known parts of this country."]

ALLEN, J[OEL] A[SAPH]. 1890. *Notes on collections of mammals in central and southern Mexico, by Dr. Audley C. Buller, with descriptions of new species of the genera Vespertilio, Sciurus, and Lepus.* Bull. Amer. Mus. Nat. Hist. 3: 175–194. ["Dr. Buller's collection of mammals is one of the most extensive ever received from Mexico from a single collector." Buller collected in Tehuantepec in 1890 and in Jalisco in 1889 and 1890.]

ALLEN, J[OEL] A[SAPH]. 1895. *On a collection of mammals from Arizona and Mexico made by Mr. W. W. Price, with field notes by the collector.* Amer. Mus. Nat. Hist. Bull. 7: 193–258. [Most of the collections reported here were taken in Arizona, but B. C. Condit, who worked with W. W. Price, also collected in the Huasavas Mountains in northern Sonora. A brief itinerary is included.]

ALLEN, J[OEL] A[SAPH]. 1897. *Further notes on mammals collected in Mexico by Dr. Audley C. Buller, with descriptions of new species.* Bull. Amer. Mus. Nat. Hist. 9: 47–58. [Buller collected in Mexico during the period 1889–1895. Species covered in this paper were collected in the states of Colima in 1890 and Jalisco in 1893.]

ALTAMIRANO, F[ERNANDO]. 1891. *Reseña de una expedición científica al estado de Michoacán.* Estudio 4: 62–65. [A brief account of an expedition, centering in Pátzcuaro, to make scientific observations on the climatology, fauna, and flora of Michoacán. Localities visited are indicated in a table of climatological data, and a list is appended of the most common plants flowering in December in the vicinity of Pátzcuaro.]

ALTAMIRANO, F[ERNANDO]. 1897. *Notas de una excursión científica a Chimalapam.* Anal. Inst. Méd. Nac. Méx. 3: 39–41. [An account of a visit to Chimalapan, west of Mexico City in the Serranía de Las Cruces, to make observations on climatology and vegetational cover. Forest destruction is noted and an altitudinal profile is presented.]

ALTAMIRANO, F[ERNANDO]. 1904a. *Excursión científica al Estado de Guerrero, por el Dr. F. Altamirano, en Diciembre de 1903.* Anal. Inst. Méd. Nac. Méx. 6: 18–21. [An account of an excursion to central Guerrero, with special attention to plants of economic importance, in particular the "arbol de Linaloé" (not otherwise identified). A skeletal itinerary is given.]

ALTAMIRANO, F[ERNANDO]. 1904b. *Excursión científica a Michoacán. Octubre de 1904. En compañía de los Snres. Cyrus Pringle, George R. Shaw, y Filomeno L. Lozano.* Anal. Inst. Méd. Nac. Méx. 6: 341–355. [Itinerary of botanical trip.]

ALTAMIRANO, F[ERNANDO]. 1905. *Memoria acerca de una excursión botánica al estado de Querétaro.* Anal. Inst. Méd. Nac. Méx. 7: 389–425. [Travel account and description of vegetation.]

ALTAMIRANO, F[ERNANDO]. 1908. *Memoria sobre algunas exploraciones botánicas practicadas en Diciembre de 1907 por el Dr. F. Altamirano.* Anal. Inst. Méd. Nac. Méx. 10: 15–40. [Travels from Mexico City to Saltillo and Monterrey; and from Mexico City to Pachuca, Teocalco, and Temoaya to Actopan. A visit to a rubber factory in Saltillo utilizing guayule (*Parthenium argentatum*) is reported, followed by a discussion of the vegetation in relation to elevation. Other general sections follow on the work of the Instituto Médico Nacional.]

ALTIG, RONALD. 1979. *Toads are Nice People.* Columbia, Missouri: Gates House/Manco, 115 pp. [The chapter on Mexico is an "imaginary conglomerate of several actual trips"; mentions San Fernando, and Victoria, Tamps., Tamazunchale, and Pachuca, Hgo., Huatusco, Veracruz, Tabasco, and Chiapas. No dates are given for the various trips. The collection and study of frogs and salamanders is covered.]

ANDERSON, EDWARD F. 1958. *A recent field trip in search of Ariocarpus.* Cact. Succ. J. 30(6): 171–174. [Travel to Saltillo, Parras, Matehuala, and southeast of Cd. Victoria; mostly descriptive of the plants encountered.]

ANDERSON, ROBERT S. 1992. *Weevil collecting in Chiapas, Mexico*. Curculio, No. 32, pp. 6–7. [Two weeks were spent during September 1991 collecting weevils in high altitude sites in central Chiapas.]

ANDERSON, SYDNEY. 1972. *Mammals of Chihuahua, taxonomy and distribution.* Bull. Amer. Mus. Nat. Hist. 148(2): 153–410. [Contains a detailed account (pp. 216–219) of mammal collecting conducted by United States scientists in Chihuahua from 1853 to 1972. Includes information on collectors, dates of activity, routes of travel, collection localities, number of specimens collected, and disposition of specimens. A useful contribution to the history of mammal collecting in northern Mexico.]

ANONYMOUS. 1846. [*Notices about Theodor Hartweg.*] J. Roy. Hort. Soc. 1: 169–170. [Briefly relates Hartweg's travels in 1845 to Mexico, where he collected plants from Veracruz on the east coast to Tepic on the west coast of Mexico.]

ANONYMOUS. 1866. *La expedición científica en México por el Sr. D. Ramón de la Sagra.* Bol. Soc. Geogr. Estad. 12: 113–120. [After a brief introduction by the anonymous author, the major portion of the paper quotes de la Sagra on the economic development of Mexico and, against this background, on the geographic, ethnographic, and natural history exploration of the country. Under the last heading the author mentions Francisco Hernández, Casimir Gómez de Ortega, Luis Née, and Sessé and Mociño. It is worth commenting parenthetically that de la Sagra never collected in Mexico. Of greatest interest is an extended quotation from the "Memories et Souvenirs, publiés par son fils" (1862) of A. P. de Candolle concerning the famous botanical paintings of Mociño, his conversations with and correspondence with Mociño, and the detailed story of how these paintings were copied by a veritable army of copyists in Geneva in a matter of days.]

ANONYMOUS. 1868. [*Botanische Erforschung.*] Flora 51: 77–78. [A French expedition was sent to Mexico for natural history collections in the years 1854–1866, and E. Bourgeau (1813–1877) was the botanist. Six plant collections were sent to France, including approximately 3600 species, frequently in sets of 15–20 or sometimes more.]

ANONYMOUS. 1898–1903. *Noticia de su muerte.* Naturaleza, ser. 3, 3: 682. [Obituary of José N. Rovirosa.]

ANONYMOUS. 1904. *Die Reisen des Sammlers C. A. Purpus in Mexiko im Jahre 1903.* Gartenwelt 8: 378–380. [Describes the travels in Mexico of C. A. Purpus in 1903, one of his very active years, and names many of the plants he collected. Trips mentioned include collections made on Popocatépetl and Ixtaccíhuatl, a visit to Arizona and Sonora, collecting around Orizaba and Córdoba in Veracruz, and visits to Puebla, Jalisco, and Coahuila.]

ANONYMOUS. 1906a. *Zacuapan, Huatusco (Mexiko).* Gartenwelt 11: 32–33. [Quotes a letter received from C. A. Purpus about his plant collecting activities in Veracruz (and other states), with special mention of new species and genera collected.]

ANONYMOUS. 1906b. *Mexico.* Gard. Chron., ser. 3, 39: 84. [Mexican travels of J. G. Lemmon and Sara Plummer Lemmon, who collected plants primarily in Arizona but also in Sonora in 1905.]

ANONYMOUS. 1910. [*Charles Reid Barnes*]. Bot. Gaz. 49: 321–324. [Barnes made extensive field studies and collections in Mexico in 1906 and 1908 while investigating morphological problems in bryophytes.]

ANONYMOUS. 1951. *Nota necrológica.* Bol. Soc. Bot. Méx. 12: 37. [Obituary notice for Cassiano Conzatti, an important plant collector in Mexico, especially in Oaxaca, and author of significant publications.]

ANONYMOUS. 1988. *Hernando Sánchez-Mejorada.* Brit. Cact. Succ. J. 6(3): 73. [Obituary of important Mexican cactologist.]

ANTHONY, A. W. 1893. *Birds of San Pedro Martir, Lower California.* Zoe 4(3): 228–247. [Mostly a list of birds collected with notes on abundance, distribution, etc., but some travel information during the period April 17–June 7, 1893, is included in the introductory section.]

APPELIUS, MARIO. 1931. *El Aguila de Chapultepec. Méjico bajo los Aspectos Geográfia, Histórico, Etnico, Político, Natural, Social y Económica.* Barcelona, 430 pp. [A travel book with descriptions of plants and forests of Chiapas.]

ARNAUD, PAUL H[ENRI], JR. 1970. *The Sefton Foundation Orca Expedition to the Gulf of Mexico, March–April, 1953. General Account.* Occ. Pap. Calif. Acad. Sci., no. 86, 37 pp. [Log of trip touching at several points along the coast of Baja California, adjacent islands, and Sonora; emphasis is on collecting arachnids, insects, fishes, and reptiles.]

AUDUBON, JOHN WOODHOUSE. 1984. *Audubon's Western Journal 1849–1850. Being the Manuscript Record of a Trip From New York to Texas and an Overland Journey Through Mexico and Arizona to the Gold-Fields of California.* Tucson: Univ. Arizona Press, 249 pp. [Originally published in 1906 by A. H. Clark, Cleveland, Ohio. John W. Audubon, son of John James Audubon, traversed much of northern Mexico from southern Texas to Arizona on his way to the California gold fields. Despite the hardships of travel, Audubon made interesting observations on the fauna and flora of a vast area of northern Mexico. The route of travel is mapped. See also: AUDUBON, J. W. 1852. *Illustrated notes of an expedition through Mexico and California.* New York: J. W. Audubon, 48 pp., ex Cole 1978.]

BACKEBERG, CURT. 1930. *Kakteenjagd zwischen Texas und Patagonien.* Berlin: Brehm Verlag, 127 pp. [This is a narrative account with descriptions and photographs of cacti. It is more about cacti than about travel. According to Langman (1964), this is a "Rather flowery description of a trip with beautiful pictures of the cacti." Verdoorn (1945) describes it as "A well-illustrated account by one of the most successful, professional cactus collectors." Another edition has been published: BACKEBERG, CURT, AND G. D. DUURSMA. 1932. *Cactusjacht tussen Texas en Patagonië.* Amsterdam: Cosmos, 125 pp. See also: West, James. 1931. Cact. Succ. J. 30(11): 472, for review of Backeberg's book.]

BACKEBERG, CURT. 1951. *Stachlige Wildnis. 80000 Km durch die Urwelt Amerikas.* Berlin: Neumann, 294 + 2 pp. [An account of multiple trips in South America, Central America, and Mexico to study and collect cacti. The section dealing with Mexico is entitled "Durch die Kakteenwelt Mexikos," pp. 218–285, and includes travel in the states of Guerrero, Hidalgo, San Luis Potosí, and Puebla; several photographs of cacti.]

BAKER, FRANK COLLINS. 1895. *A Naturalist in Mexico, Being a Visit to Cuba, Northern Yucatan, and Mexico.* Chicago: David Oliphant, 145 pp. [This is a narrative of an expedition of the Academy of Natural Sciences of Philadelphia. After a short visit to Cuba, the expedition traveled to Yucatán, later visited Veracruz and the Mexico City area. Baker was mostly interested in collecting mollusks but birds are frequently mentioned. See: Witmer Stone (Science, n.s. 2(44): 592–593, 1895) for criticism of Baker's book,

including accusations of plagiarism, lack of acknowledgments, and inaccuracies in names and events.]

BAKER, ROLLIN H[AROLD]. 1956. *Mammals of Coahuila, Mexico.* Univ. Kansas Publ. Mus. Nat. Hist. 9(7): 125–335. [Presents a brief history of exploration for mammals in Coahuila. The activities of many collectors are mentioned. In addition, the names of 30 students and staff of the University of Kansas are listed as having collected and studied Coahuila mammals.]

BAKER, ROLLIN H[AROLD]. 1991. *The classification of neotropical mammals—A historical résumé*, pp. 7–32, in *Latin American Mammalogy, Biodiversity and Conservation* (M. A. Mares and D. J. Schmidly, eds.). Norman: Univ. Oklahoma Press, 468 pp. [Review of the history of the collection and study of Latin American mammals, including conditions that affected scientific study of the group. These conditions also apply to other natural history disciplines in Latin America. Contains an extensive bibliography.]

BALL, GEORGE E[UGENE], AND DONALD R. WHITEHEAD. 1967. *Localities for collecting in Mexico.* Coleopt. Bull. 21(4): 122–138. [Describes insect-collecting sites in Chihuahua, Chiapas, Colima, Durango, Morelos, Oaxaca, Puebla, Querétaro, San Luis Potosí, Tamaulipas, and Veracruz.]

BALLS, EDWARD K. 1939. *Plant hunting in Mexico.* Gard. Chron., ser. 3, 105: 122–123, 138–139, 152–153. [An interesting account of botanical travel to central Mexico for eight months in 1938. Balls traveled and collected mostly at higher elevations, visiting Nevado de Toluca, Mt. Malinche (Tlaxcala), Mt. Popocatépetl, Mt. Orizaba, and Mt. Ixtaccíhuatl, among other localities. The vegetation is described in general, with some references to individual species of plants.]

BANCROFT, GRIFFING. 1932. *Lower California: A Cruise. The Flight of the Least Petrel.* New York: Putnams Sons, 403 pp. [Trip from San Diego south along the west coast of Baja California and north along the east coast with frequent stops on the peninsula and islands along the way; trip of four months made in 1930; mostly interested in birds but other groups were also collected.]

BANKS, RICHARD C. 1962. *A history of explorations for vertebrates on Cerralvo Island, Baja California.* Proc. Calif. Acad. Sci., ser. 4, 30(6): 117–125. [A concise history for the period 1895–1960 of the study and collection of terrestrial vertebrates on Cerralvo Island, the southernmost island in the Gulf of California.]

BARBER, H[ERBERT] S[PENCER]. 1928. *Thomas Say's unrecorded journey to Mexico.* Entomol. News 39: 15–20. [During 1827–1828 Thomas Say traveled by ship from New Orleans to Veracruz and then overland to Mexico City. Insects described by Say from this trip were designated by the comment "Inhabits Mexico." The actual collection localities of these specimens remain in doubt, but according to Barber they must have been collected "Along the old road between Vera Cruz, Jalapa, Mexico City and Tacuba." See also: Stroud (1992); Weiss & Ziegler (1931).]

BARBOUR, MARY B. 1932. *Leaves From My Diary.* Boston: Privately printed, 127 pp. ["One hundred copies printed in January 1932 at the Harvard University Press." This a day-by-day narrative of a trip in 1931 on the ship *Utowana* to western Mexico via the Panama Canal. The author was the daughter of Thomas Barbour, herpetologist and frequent writer about the natural history of tropical America. The party was accompanied on part of the trip by three botanists ("the Bots"), T. H. Kearney, G. N. Collins,

and J. H. Kempton. Some plants and animals were collected, especially snakes and lizards (collected by Thomas Barbour), in Baja California, on islands in the Gulf of California, and at a few places on the Mexican mainland as far north as Guaymas. This travelogue contains a rather small amount of natural history information, although some serious collecting was conducted in western Mexico from March 27 to April 10, 1931.]

BARCO, MIGUEL DEL. 1973. *Historia Natural y Crónica de la Antigua California.* Miguel León-Portillo (ed.). Mexico: Univ. Nac. Autón. Méx., 446 pp. [An early description of the natural history of Baja California by a Jesuit missionary.]

BARNHART, JOHN HENDLEY. 1927. [*Jean Jules Linden collecting localities*]. J. New York Bot. Gard. 28(333): 210–211. [Describes Linden's collecting trips in America, including Mexico. Linden was accompanied on his Mexican travels by Nicolas Funck (1816–1896) as artist and Auguste Boniface Ghiesbreght (1810–1893) as zoologist; both also became well-known plant collectors.]

BARNHART, JOHN HENDLEY. 1965. *Biographical Notes Upon Botanists.* Boston: G. K. Hall & Co., vol. 1, 563 pp., vol. 2, 549 pp., vol. 3, 545 pp. [List of botanists with brief biographical data: dates and place of birth and/or death, education, some bibliographical material on biographies, occupation (if not professional botanist), and general interests. Good for dates and places of birth and death, and bibliography of biographies. Contains information on many who collected in Mexico.]

BARRETT, ELLEN C. 1957. *Baja California 1535–1956. A Bibliography of Historical, Geographical and Scientific Literature Relating to the Peninsula of Baja California and the Adjacent Islands in the Gulf of California and the Pacific Ocean.* Los Angeles: Bennett and Marshall, 284 pp. [Annotated bibliography containing many items of interest concerning natural history and naturalist's travels. Well indexed.]

BARRETT, ELLEN C. 1967. *Baja California II 1535–1964. A Bibliography of Historical, Geographical and Scientific Literature Relating to the Peninsula of Baja California and the Adjacent Islands in the Gulf of California and the Pacific Ocean, Including a Chronological Index to Books I and II.* Los Angeles: Westernlore Press, 250 pp. [Many publications on natural history travel in the area are included with brief annotations.]

BARTLETT, HARLEY HARRIS. 1932. *A biological survey of the Maya area.* Bull. Torrey Bot. Club 59: 7–20. [A general review of the history of botanical exploration and publications on plants in the "Maya" area, including roughly the Yucatan Peninsula, adjacent states of Chiapas, Veracruz, and Tabasco in Mexico, and Guatemala. Major collectors mentioned: G. F. Gaumer (first specimens of plants collected in 1885–86); C. F. Millspaugh (1894 in Yucatán); Profilo Valdez (1887–1896); Witmer Stone; Eduard and Caecilie Seler (1902–1911); J. M. Greenman (1906); G. N. Collins (1912–13); J. C. Bequaert (1929); Arthur Schott (1864–66); and C. L. Lundell.]

BARTLETT, JOHN RUSSELL. 1854. *Personal Narrative of Explorations and Incidents in Texas, New Mexico, California, Sonora, and Chihuahua, Connected With the United States and Mexican Boundary Commission, During the Years 1850, '51, '52, and '53.* New York: D. Appleton and Company, vol. 1, 506 pp., vol. 2, 624 pp. [This is an account of the travels made during the United States–Mexico Boundary Survey, with incidental reference to the

collections of botanists and zoologists (J. M. Bigelow, J. H. Clark, C. C. Parry, George Thurber, Arthur Schott, Thomas H. Webb, and Charles Wright) associated with the Survey. One short chapter is devoted to the natural history of the regions traversed, and many references are made to plants and animals in other parts of the books. The Rio Grande Press, Inc., reprinted this two-volume work in 1965 with a new introduction. See also: JOHN JENKINS. 1983. *Basic Texas Books*, pp. 30–32, for an assessment and bibliographical account of this work.]

BARTLETT, RICHARD D. 1988. *In Search of Reptiles and Amphibians*. New York: E. J. Brill, 363 pp. [Description of several herpetological trips to various areas of Mexico, pp. 248–295.]

BAXTER, EDGAR. 1930. *A trip to Magdalena Bay*. J. Cact. Succ. Soc. Amer. 2(4): 323–327. [Cactus collecting.]

BEATY, JANICE J. 1964. *Plants In His Pack. A Life of Edward Palmer, Adventurous Botanist and Collector*. New York: Pantheon Books, 182 pp. [A book for young readers; chapters 14 and 15 deal with Palmer's plant-collecting travels in Mexico. See McVaugh (1956) for a more thorough account of Palmer and his travels in Mexico.]

BECK, HANNO. 1959, 1961. *Alexander von Humboldt.* Wiesbaden: Franz Steiner Verlag GMBH, Band I (1959), 303 pp.; Band II (1961), 439 pp. [Stafleu and Cowan (1979) consider this the "main recent biography" of Humboldt. The travels of Humboldt and Bonpland in Mexico are covered in Band I, pp. 213–223.]

BEEBE, C[HARLES] WILLIAM. 1905. *Two Bird-Lovers in Mexico.* Boston: Houghton-Mifflin & Co., 407 pp. [Narrative of a trip of four months in 1903–1904 to Veracruz, Guadalajara, barrancas near eastern and southern slopes of Volcán Colima, near Manzanillo, and Chapala to collect and study birds. Beebe was accompanied by his wife, Mary, who wrote the last chapter "How we did it." This is the first of Beebe's many natural history travel books. For an assessment of the book and a biography of Beebe see: WELKER, ROBERT HENRY. 1975. *Natural Man. The Life of William Beebe.* Bloomington: Indiana University Press. TIM BERRA (1977. *William Beebe. An Annotated Bibliography*. Hamden, Connecticut: Archon Books) presents some additional biographical material on Beebe and a bibliographical account of all of his publications, including references to reviews of his books.]

BEEBE, [CHARLES] WILLIAM. 1937. *The Templeton Crocker Expedition II. Introduction, itinerary, list of stations, nets and dredges.* Zoologica 22: 33–46. [Detailed account of marine and terrestrial collections made on the *Zaca*, March 25–May 25, 1936, along the Pacific Coast of Baja California and in the lower Gulf of California. The narrative of the expedition was published in Beebe's *Zaca Venture*, 1938.]

BEEBE, [CHARLES] WILLIAM. 1938. *Zaca Venture*. New York: Harcourt, Brace & Co., 308 pp. [Narrative of trip on the schooner *Zaca*, March 25–May 25, 1936, along the west coast of Baja, into the Gulf of California and southwest to Clarion Island to collect marine and terrestrial animals. See the previous entry for a detailed itinerary and list of collecting stations.]

BEEBE, [CHARLES] WILLIAM. 1942. *Book of Bays.* New York: Harcourt, Brace & Co., 302 pp. [Narrative of a five months trip during 1938–1939 along the

west coast of Mexico and Central America sponsored by the New York Zoological Society; the primary objectives were to collect and study marine animals. This was an extension of the expedition described in *Zaca Venture*, travelling southward along the west coasts of Mexico and Central America.]

BELDING, L[YMAN]. 1887. *Collecting in the Cape Region of Lower California.* West Amer. Sci. 3(24): 93–97. [Belding presents a narrative of his collecting trips to Baja California in the period 1881–1883, during which he collected reptiles, amphibians, and birds.]

BELTRÁN, ENRIQUE. 1943. *Setenta y cinco años de ciencias naturales en México.* Rev. Soc. Méx. Hist. Nat. 4(3–4): 245–264. [A careful and detailed history of all of the natural sciences in Mexico from the sixteenth century forward (not only the 75 years indicated in the title). The role of exploration and natural history collectors is not especially emphasized.]

BELTRÁN, ENRIQUE. 1946. *Prologo*, pp. v–x, in *Flora Taxonómica Mexicana (Plantas Vasculares)*, Tomo 1, Cassiano Conzatti, Mexico, D.F., 378 pp. [Discusses history of botany in Mexico with analysis of the life and work of Cassiano Conzatti.]

BELTRÁN, ENRIQUE. 1949. *Veinticinco años de ciencias biológicas en Mexico.* Rev. Soc. Méx. Hist. Nat. 10(1–4): 17–26. [A highly personalized account of the history of Mexican biology over the preceding 25 years. Little account is given of the work of explorers and collectors.]

BELTRÁN, ENRIQUE. 1951a. *El panorama de la biología mexicana.* Rev. Soc. Méx. Hist. Nat. 12(1–4): 69–99. [A broad history of the development of biology in Mexico from pre-conquest times to the present. Numerous individuals are mentioned, and portraits are presented of Alfred Dugès, Cassiano Conzatti, Enrique Beltrán, and Alfonso Herrera. The role of institutions and professional societies is emphasized.]

BELTRÁN, ENRIQUE. 1951b. *La vida de un hombre ejemplar: Cassiano Conzatti.* Rev. Soc. Méx. Hist. Nat. 12(1–4): 303–318. [A detailed biographical account (with a portrait) of the Italian-Mexican Cassiano Conzatti, best known as a collector of Oaxacan plants and as author of significant floral works on Mexican plants.]

BELTRÁN, ENRIQUE. 1961. *Un cuarto de siglo de zoologia mexicana, 1936–1961.* Rev. Soc. Méx. Hist. Nat. 22: 113–152. [A broad overview of the history of the study of zoology in Mexico from pre-conquest times to the present. Brief reviews of the early zoological reports of Spanish settlers and officials are given, including those of Francisco Hernández, Jesús Sánchez, Díaz de León, among others, as well as the zoologists of more recent times. The history of the development of zoological texts as well as institutions and professional societies is also presented.]

BENTHAM, GEORGE. 1844, 1846. *The Botany of the Voyage of H.M.S. Sulphur Under the Command of Capt. Sir Edward Belcher During the Years 1836–1842.* London: Smith, Elder and Co., 195 pp. + atlas. Facsimile reprint 1968. Lehre: J. Cramer. [This work was edited by Richard Brinsley Hinds and includes information on collections made by G. W. Barclay and A. Sinclair. Localities visited in western Mexico are listed. Part III, "Western Tropical America, from Mexico to Guayaquil," pp. 58–178, deals with the travels and work in Mexico.]

BEQUAERT, J[OSEPH] C. 1933a. *Botanical notes from Yucatan.* Carnegie Inst. Wash. Publ. 431, pp. 505–524. [This paper is mostly descriptive of the vegetation of Yucatán but does contain information on travel by the author and mentions other collectors. This is part of a large work edited by GEORGE C. SHATTUCK entitled *The Peninsula of Yucatan. Medical, Biological, Meterological and Sociological Studies*, Carnegie Inst. Wash. Publ. 431, 576 pp. The three expeditions took place in 1929, 1930, and 1931, and were conducted under the auspices of the Carnegie Institution. The studies were mostly medical in nature, but there is also much information presented on the history, geography, and natural history of the Yucatan Peninsula.]

BEQUAERT, J[OSEPH] C. 1933b. *Contribution to the entomology of Yucatan.* Carnegie Inst. Wash. Publ. 431, pp. 547–574. [Bequaert discusses the history of insect collecting and study in Yucatán.]

BEQUAERT, J[OSEPH] C., AND W. J. CLENCH. 1933. *The non-marine mollusks of Yucatan.* Carnegie Inst. Wash. Publ. 431, pp. 525–546. [Discusses history of collecting mollusks in Yucatán.]

BERLANDIER, JEAN LOUIS. 1980. *Journey to Mexico During the Years 1826 to 1834* (translated by S. M. Ohlendorf, J. M. Bigelow, and M. M. Standifer). Austin: Texas State Hist. Assoc., vol. 1: 1–287, vol. 2: 288–672. [Berlandier's travels in Mexico are chronicled through use of his letters and manuscripts. C. H. Muller provides an extended introduction, which includes biographical material on Berlandier and background information relating to his botanical activities. Included as appendices are a facsimile of the botanical part of the rare "Memorias de la Comisión de Limites" and "Berlandier's records of shipments and collections [plants]." The work is extensively footnoted with information pertinent to understanding the text and its botanical contents. C. H. Muller and Katherine K. Muller provide botanical notes. There is also a very helpful index. This work is a valuable contribution to the knowledge of Berlandier's travels in Mexico and his plant collections. In addition to the considerable reference to plants, Berlandier describes in detail much of the topography, history, customs, and general natural history of Mexico. Maps of Berlandier's routes in Texas and Mexico are included.]

BEYER, ELLA A. 1976. *G. Beyer—Entomologist.* Carmel, California: Privately printed, 43 pp. [Contains letters written by Gustav Beyer during the period February 17, 1901–September 30, 1901 about his experiences while collecting beetles in the Cape Region of Baja California.]

BIART, LUCIEN. n.d. [1871 ?]. *The Adventures of a Young Naturalist.* (Edited and adapted by Parker Gillmore.) New York: Harper and Brothers, Publishers, 491 pp. [This is a fictional natural history adventure written for young readers. The central character is a young boy who in 1864 accompanies his father, a "Swiss savant," and "an Indian of the Mistec race" on a trip through the "Cordilleras of Mexico." Many plants and animals are mentioned, some by their scientific names. Biart (1829–1897) was a French novelist, poet, and writer of travel stories. This book was originally published in 1869 under the title *Aventures d'un jeune naturaliste*. See Langman (1964) and León (1895) for additional bibliographical information on this publication.]

BINFORD, LAURENCE C. 1989. *A Distributional Survey of the Birds of the Mexican State of Oaxaca.* Ornithol. Monog. No. 43, Amer. Ornith. Union, Washington, D.C., 418 pp. [Briefly describes the history of bird study in Oaxaca,

mentioning among others, the collectors Ferdinand Deppe, Adolphe Boucard, Auguste Sallé, and A. L. François Sumichrast. There is a lengthy gazetteer.]

BLACKWELDER, RICHARD E. 1979. *The Zest for Life or Waldo Had a Pretty Good Run. The Life of Waldo LaSalle Schmitt.* Lawrence, Kansas: Allen Press, Inc., 234 pp. [Schmitt, a specialist in Crustacea and longtime Smithsonian Institution scientist, visited Mexico several times. The first trip was to Baja California in 1911 as a member of the Bureau of Fisheries expedition on the *Albatross*; he collected on Guadalupe Island, the San Benito Islands, and as far north in the Gulf of California as Angel de la Guardia Island. Later collecting trips to Baja California occurred as part of the Allan Hancock Expeditions. In 1960 Schmitt accompanied an expedition to Yucatán.]

BLAKE, S. F. 1945. *Asteraceae described from Mexico and the southwestern United States by Marcus E. Jones, 1908–1935.* Contr. U.S. Natl. Herb. 29: 117–137. [A commentary on Jones' life and work, with an annotated listing of Asteraceae collected by Jones. In an extended footnote on p. 120, Blake locates many of Jones' enigmatic collecting localities.]

BLATCHLEY, W[ILLIS] S[TANDLEY]. 1892. *Entomologizing in Mexico.* Entomol. News 3: 111–114, 131–136. [Blatchley describes a trip with the "Scoville expedition" to Mexico during which he collected insects in and around Orizaba and Fortín. A considerable amount of the discussion centers around butterflies, but Orthoptera and Hemiptera are also mentioned. In *Blatchleyana* (Blatchley, 1930. Indianapolis: The Nature Publishing Co.), Blatchley states "In summer of 1891 [he] was one of five members of the J. T. Scovell Expedition to determine height..., and natural features of Volcano Orizaba...".]

BOIS, M. D. 1926. *Léon Diguet, explorateur-naturaliste, correspondant du Muséum.* Bull. Mus. Hist. Nat., Paris, 32(5): 333–335. [Biographical; travel and collecting in Mexico.]

BOIVIN, B. 1977. *A basic bibliography of botanical biography and proposal for a more elaborate bibliography.* Taxon 26(1): 75–105. [Although containing relatively little about Mexico per se, this is an excellent guide to bibliographies of biographies of botanists, some of whom worked in Mexico.]

BOKE, NORMAN H. 1962. *A botanist looks at Mexico.* Bios 33: 187–199. [A general introduction to natural areas of Mexico and the logistics of natural history collecting there (in 1962). There is no account of travel, but some information is presented on location of species of cacti; photographs of cacti.]

BOMMER, J. E. 1858. *Nécrologie* [*H. G. Galeotti*]. Hort. Prat. 2: 94–96. [Mexican travels of Henri Guillaume Galeotti during the period 1835–1840, mainly in the Central Plateau area.]

BONTA, MARCIA MYERS. 1991. *Women in the Field. America's Pioneering Women Naturalists.* College Station: Texas A&M Univ. Press, 299 pp. [Information is presented on plant-collecting trips of Ynés Mexia and Katharine Brandegee in Mexico.]

BOTTING, DOUGLAS. 1973. *Humboldt and the Cosmos.* New York: Harper and Row Publ., 295 pp. [A general and well-illustrated work on Alexander von Humboldt, including a brief section on his travels in Mexico.]

BOUCARD, ADOLPHE. 1894. *Travels of a Naturalist. The Record of Adventures, Discoveries, History and Customs of Americans and Indians, Habits, Descriptions of Animals, Chiefly Made in North America, California, Mexico, Central America, Colombia, Chili, etc. During the Last Forty-two Years.*

Bournemouth: Pardy & Sons, 204 pp. [Boucard was primarily interested in birds and beetles, and he traveled extensively in tropical America, including southern Mexico. He published on a variety of natural history subjects during the period 1870–1895. In this book of travels, compiled from a series of papers published in *The Hummingbird*, a brief series edited by Boucard 1891–1895, there is reference to a stop at Acapulco in 1852 in which he describes the history of the area and its commercial aspects but mentions little about the natural history. There are a number of brief biographical sketches of Boucard, including those of J. A. Allen (*The Auk*, 1905), T. S. Palmer (*Condor* 19: 168, 1917), W. F. H. Rosenberg (*Condor* 26: 38–39, 1924), among others.]

Bowers, Janice Emily. 1988. *A Sense of Place. The Life and Work of Forrest Shreve.* Tucson: Univ. Arizona Press, 195 pp. [Shreve's travels in Sonora and Baja California to study desert ecology are briefly described. See: Knobloch (1979) for a list of Mexican localities visited by Shreve.]

Boynton, Mary Fuertes. 1956. *Louis Agassiz Fuertes, His Life Briefly Told and His Correspondence Edited.* New York: Oxford Univ. Press, 317 pp. [Fuertes, a well-known bird painter, describes in a few letters his ornithological visit to Mexico with Frank M. Chapman in 1910; he visited the Yucatan, Veracruz, and Tampico areas.]

Bracelin, H. P. 1938. *Ynés Mexia.* Madroño 4(8): 273–275. [Biography; portrait; list of plant-collecting expeditions to Mexico.]

Brandegee, Townshend S[tith]. 1889. *A collection of plants from Baja California, 1889.* Proc. Calif. Acad. Sci., ser. 2, 2: 117–216. [This paper consists mostly of a long list of plants with notes and descriptions, but also contains an account of the travels of the author and a map of his routes.]

Brandegee, T[ownshend] S[tith]. 1890. *Notes concerning the collection of plants made by Xantus at Cape St. Lucas and vicinity.* Zoe 1: 269–272. [A brief discussion of localities visited by John Xántus between August, 1859, and February, 1860, together with comments on plants he did and did not collect. See also: Madden (1949), Zwinger (1986), and Xántus (1976).]

Brandegee, T[ownshend] S[tith]. 1900. *Voyage of the Wahlberg.* Zoe 5(2): 19–28. [Account of a voyage that started from San Diego in March, 1897, landing and collecting on most of the islands along the west coast of Baja California and continuing to Socorro, Clarión, and San Benedicto islands. Botanical collections were by A. W. Anthony and A. L. Stockton in Baja California and on offshore islands; cf. Purpus, 1899.]

Brandegee, T[ownshend] S[tith]. 1905. *Plants from Sinaloa, Mexico.* Zoe 5(10): 196–226. [Brief itinerary of August–November, 1904, trip.]

Brassfield, Carl F. 1939. *Lower California, Mexico.* Cact. Succ. J. 10(10): 166–167. [Narrative of a brief cactus-collecting trip to Baja California.]

Bravo Hollis, Helia. 1936. *Noticia de su muerte.* Anal. Inst. Biol. Méx. 7: 167. [Obituary of Jesús González Ortega, an important resident plant collector in Sinaloa.]

Breedlove, Dennis E. 1981. *Introduction to the Flora of Chiapas.* Part 1, in *Flora of Chiapas*, California Acad. Sci., 35 pp. [Contains a brief history of botanical exploration in Chiapas, including some biographical information on botanists who worked there.]

Bridson, Gavin D. R. 1994. *The History of Natural History. An Annotated Bibliography.* New York, N. Y.: Garland Publishing, Inc., 740 pp. [This is Volume

24 of *Bibliographies on the History of Science and Technology.* It is a general and highly useful guide to literature on the subject, including references to biographies of many naturalists as well as histories of general natural history, natural history societies, subdisciplines of biology, explorations, and much more. There are relatively few references specifically involving naturalists and their work in Mexico, and most of these are included in the present bibliography; however, Bridson's bibliography is important for its general and comprehensive coverage of natural history. It is well indexed by subject, geographical areas covered, and names.]

BRIQUET, JOHN. 1940. *Biographies des botanistes a Genève de 1500 a 1931.* Bull. Soc. Bot. Suisse, 50a, 494 pp. [Information presented on two important plant collectors in Mexico: Jean Louis Berlandier (pp. 36–39), and Thomas Coulter (pp. 196–198). Travels of Berlandier included the states of Tamaulipas, Coahuila, Nuevo León, San Luis Potosí, México, Distrito Federal, Morelos, and Veracruz. There is a concise biography of Coulter that includes his plant collecting in Mexico (1824–1831) in the states of Hidalgo, Veracruz, Sonora, and Jalisco, among others.]

BROADDUS, M. J. 1935. *Marcus E. Jones, M.A. Biographical sketch.* Contr. West. Bot. 18: 152–157. [Biography of Jones by his daughter, including some information on his travels and plant collections in Mexico.]

BROOKS, PAUL. 1964. *Roadless Area.* New York: Alfred A. Knopf, 260 pp. [In the chapter "Mexico's California," Brooks describes a visit to Baja California with naturalists of the Belvedere Scientific Fund Expedition. He traveled to Mulegé, Concepción Bay, Los Angeles Bay, and Isla Raza.]

BRYANT, WALTER E. 1889. *A catalogue of the birds of Lower California, Mexico.* Proc. Calif. Acad. Sci., ser. 2, 2: 237–320. [Reviews the early history of bird collecting in Baja California and describes the author's own travels in 1888 and 1889 while collecting birds there.]

BRYANT, WALTER E. 1891a. *Andrew Jackson Grayson.* Zoe 2: 34–68. [A biographical account of Grayson, who collected and painted birds in Mexico, with information on his itineraries. Grayson lived in Mazatlán, Sinaloa, and collected mostly in that area but also made collecting trips to Islas Tres Marías and to Socorro Island.]

BRYANT, WALTER E. 1891b. *The Cape Region of Baja California.* Zoe 2(3): 185–201. [Narrative of observations and itinerary of September–November, 1890, trip with T. S. Brandegee; collections of birds and mammals (Bryant) and plants (Brandegee).]

BULLOCK, WILLIAM. 1824. *Six Months Residence and Travels in Mexico. Containing Remarks on the Present State of New Spain, It's Natural Productions, State of Society, Manufactures, Trade, Agriculture, and Antiquities, Etc.* London: John Murray, 532 pp. [Bullock was one of the first English naturalists to travel in Mexico. He travelled between Veracruz and Mexico City, where he observed and collected animals, especially birds. This is an interesting early travel account, but although Bullock collected many specimens, he did not discuss much natural history in the narrative. Several editions and reprints have been issued, including a 1971 Kennikat Press reprint.]

BURKHALTER, LOIS WOOD. 1965. *Gideon Lincecum 1793–1874. A Biography.* Austin: Univ. Texas Press, 362 pp. [In 1868, Lincecum, an early Texas naturalist, moved to Mexico, where he established a farm on the Tuxpan River in the state of Veracruz. During his five-year stay there he collected plants

and animals. Specimens of several animal groups were sent to S. F. Baird at the Smithsonian Institution; none of his Mexican plant collections is known to be extant, although some of his Texas collections survive.]

BUTANDA, ARMANDO. 1992. *Ida Kaplan Langman (1904–1991).* Acta Bot. Mex. 17: 3–5. [Obituary and bibliography of the author of *A Selected Guide to the Literature on the Flowering Plants of Mexico*, an invaluable source for botanical publications for the country.]

CALVERT, PHILIP P[OWELL]. 1907. *An entomological journey in Mexico, with special reference to Odonata.* Entomol. News 18(5): 231–237. [Itinerary of trip (August 6–September 23, 1906), mostly in the Central Plateau region of Mexico, but also in Sonora. See Mallis (1971) for brief biography of Calvert.]

CAMP, W[ENDELL] H[OLMES]. 1937a. *Winter in Oaxaca.* J. New York Bot. Gard. 38(450): 129–144, 153–170. [Travels of a botanist in the state of Oaxaca in 1936–1937; photographs; map. An interesting travelogue describing the country and its inhabitants, and the difficulties of travel at that time.]

CAMP, W[ENDELL] H[OLMES]. 1937b. *Professor C. Conzatti: An appreciation.* J. New York Bot. Gard. 38(449): 118–121. [Biographical; portrait; some discussion of Cassiano Conzatti's collection and study of Mexican plants.]

CARLSON, MARGERY CLAIRE, AND KATE STALEY. 1953. *In the cloud forests of Chiapas.* Americas 5(5): 20–23. [Narrative of a plant-collecting trip by the authors in Chiapas, mainly around Ocozocoautla, San Cristóbal, and Lago Montebello. The vegetation of each of the areas visited is described in a general way; photographs.]

CARMONY, NEIL B., AND DAVID E. BROWN. 1991. *Mexican Game Trails—Americans Afield in Old Mexico, 1866–1940.* Norman: Univ. Oklahoma Press, 270 pp. [An anthology of writings of hunters/naturalists in Mexico. All of the articles have a strong element of natural history, although many of the authors would not be considered as naturalists. Each essay is preceded by a short biography of the author. The epilogue is entitled "Hunting and zoological collecting in Mexico today."]

CASTELLA, MANUEL T. 1959. *4,300 kilómetros recolectando cactáceas.* Cact. Suc. Mex. 4(1): 88–94. [A cactus-collecting trip to the coasts of Colima and Jalisco, including Helia Bravo Hollis, Eizi Matuda, and the author. Travel was from Mexico City through Querétaro, Celaya, Aguascalientes, to Zacatecas, where some collecting was done. Subsequent collecting was done around Concepión del Oro, Saltillo, and Durango, after which the coast was reached at Mazatlán. The party was joined in Guadalajara by Dudley Gold and Hernándo Sánchez-Mejorada. Additional collecting stops were in Jalisco and Colima, and the final stop at Quismala (=Quixmala), from whence they returned to Mexico City. Includes photographs.]

CASTELLA, MANUEL T. 1960. *Cuatro cactolocos en excursión.* Cact. Suc. Mex. 5(1): 13–18. [The four "cactolocos" (=cactus nuts) were Jorge Meyrán, Miguel Pulido, Antonio Barberena, and the author. They traveled north from Mexico City to Saltillo and back, detailing particular stops and species of cacti observed (and collected ?).]

CAVANILLES, ANTONIO JOSÉ. 1800. *Materiales para la historia de la botánica.* Anal. Hist. Nat. 2(4): 1–57. [An ambitious summarization of the history of systematic botany, including the development of the artificial and natural systems, and a history of plant explorations world-wide. The travels of Luis Née with the Malaspina Expedition are discussed on pp. 51–52.]

CHAPMAN, FRANK M[ICHLER]. 1933. *Autobiography of a Bird Lover.* New York: D. Appleton–Century Co., Inc., 420 pp. [Describes visits to Yucatan 1896, and Veracruz 1897, 1910, to study and collect birds. During the latter trip he was accompanied by the bird artist Louis Fuertes. See: Boynton (1956) for Fuertes' account of the trip.]

CHARDÓN, CARLOS E. 1949. *Los Naturalistas en la América Latina.* Tomo 1. (Los Siglos XVI, XVII y XVIII, Alejandro Humboldt, Carlo Darwin, La Española, Cuba y Puerto Rico). Sec. Esta. Agric., Pec. Colon., Cd. Trujillo, Rep. Dominicana, 386 pp. [Covers lives and travels of a large number of early naturalists (Luis Née, Thaddeus Haenke, Sessé, Humboldt, Bonpland, and Thomas Barbour) who travelled in Latin America, including some in Mexico; portraits.]

CHISZAR, DAVID, AND ROZELLA B. SMITH. 1982. *Fifty Years of Herpetology. Publications of Hobart M. Smith.* North Bennington, Vermont: John Johnson, 78 pp. [Biobibliography of Smith, who contributed much to the systematics and bibliography of Mexican herpetology. There is also a brief discussion of the early history of Mexican herpetology.]

CHRISTENSON, CORNELIA V. 1971. *Kinsey. A Biography.* Bloomington: Indiana Univ. Press, 241 pp. [Alfred C. Kinsey's travels in Mexico collecting gall wasps on oaks are described. The first trip was made in 1931 and the second in 1935–1936. His publications based on collections made on these trips greatly increased the known number of Mexican gall wasps.]

COAN, EUGENE. 1966. *Charles Russell Orcutt, pioneer Californian malacologist, and the West American Scientist.* Trans. San Diego Soc. Nat. Hist. 14(8): 85–96. [Biobibliography of Orcutt, his work on mollusks, and a collation of journals he published. Orcutt traveled and collected extensively in Mexico, much of which he related in the *West American Scientist*. The information presented on the several journals Orcutt edited and published is useful.]

COATS, ALICE M. 1970. *The Plant Hunters, Being a History of the Horticultural Pioneers, Their Quests, and Their Discoveries, From the Renaissance to the Twentieth Century.* New York: McGraw-Hill Book Co., 400 pp. [In the chapter entitled "Mexico and the Spanish Main," Coats presents an excellent review of some early plant collectors in Mexico, including Sessé and Mociño, Humboldt and Bonpland, Thomas Coulter, Theodor Hartweg, Benedict Roezl, and others. The first edition of this work was published in 1969 by Studio Vista, London. For a review of the book see: P. I. Edwards. 1972. J. Soc. Biblio. Nat. Hist. 6(2): 131–133.]

COLE, GAROLD. 1978. *American Travelers to Mexico, 1821–1972; A Descriptive Bibliography.* Troy, New York: Whitston Publ. Co., 139 pp. [Lists and annotates some publications about natural history travels in Mexico, including works by J. W. Audubon, F. C. Baker, J. R. Bartlett, F. A. Ober, and W. T. Hornaday.]

CONANT, ROGER. 1968. *Zoological exploration in Mexico—The route of Lieut. D. N. Couch in 1853.* Amer. Mus. Novit. No. 2350, 14 pp. [Conant traces Couch's collecting trip from Brownsville, Texas, westward to the Río Nazas, crossing northern Tamaulipas, Nuevo León, and Coahuila. A map of the approximate route of Couch is included. Some biographical material is also presented for Couch. It is of interest that he purchased the collections of Jean Louis Berlandier after the latter's death. Most of these collections went to the Smithsonian Institution.]

CONRAD, JIM. 1991. *On the Road to Tetlama. Mexican Adventures of a Wandering Naturalist*. New York; Walker & Co., 196 pp. [Despite the subtitle, this book is more about the people in and around Tamazunchale than about natural history. Some general references are made to plants and animals; brief discussion of some birds.]

CONZATTI, C[ASSIANO]. 1917. *Exploración botánica por la costa meridional de Oaxaca*. Bol. Dirección Estud. Biól. Méx. 2(3): 309–325. [A detailed account of a 1 1/2 month trip from Oaxaca City, south to the Pacific Coast accompanied by the forester, B. Pablo Reko. Most of the observations and collections were made from Miahuatlán south with interesting descriptions of habitats and geography. Includes a detailed itinerary, a list of plants with collection numbers and localities, as well as photographs of areas visited.]

CONZATTI, C[ASSIANO]. 1922. *Una expedición botánica a la costa oaxaqueña del suroeste*. Impr. Gob. Esta. Oaxaca, Oaxaca, 33 pp. [Account of travel and description of the vegetation of the area.]

CONZATTI, CASSIANO. 1946. *Introducción*, pp. xvii-xix, in *Flora Taxonómica Mexicana (Plantas Vasculares)*, Tomo 1, Mexico, D.F., 378 pp. [Brief comments on many collectors and botanical publications in Mexico.]

CORRELL, DONOVAN S[TEWART]. 1948a. *Wild potato collecting in Mexico*. Field & Laboratory 16(2): 94–112. [An account of Correll's 1947–1948 expedition to southcentral Mexico to collect wild and cultivated species of potatoes. Information on the travels in Mexico by other botanists from the United States, England, and Russia to study and collect potatoes is also included.]

CORRELL, DONOVAN S[TEWART]. 1948b. *Collecting wild potatoes in Mexico*. U.S.D.A. Circ. 797. 40 pp. [This is an extended account of Correll's American Potato Expedition to Mexico as described in the previous entry. The collecting areas are described more thoroughly than in the paper above. Many photographs are included.]

CORRELL, DONOVAN S[TEWART]. 1960. *A mule-train trip to Sierra Mohinara, Chihuahua*. Amer. Fern J. 50: 66–78. [Description of a trip, October 9–21, 1959, with Howard Scott Gentry to collect ferns and other plants. Country described and photographed].

CORRELL, DONOVAN S[TEWART]. 1961. *Ivan Murray Johnston (1898–1960)*. Taxon 10: 1–8. [Biography with portrait and bibliography. Johnston's plant-collecting localities included the intermontane area of northern Mexico.]

CORRELL, DONOVAN STEWART. 1962. *The Potato and Its Wild Relatives*. Renner: Texas Research Foundation, 606 pp. [Includes detailed itinerary of a 1947–1948 trip to southern Mexico to collect wild and cultivated potatoes and their relatives, and also a review of other explorations in search of potatoes in Mexico.]

COVILLE, FREDERICK V. 1895. *The botanical explorations of Thomas Coulter in Mexico and California*. Bot. Gaz. 20: 519–531. [Biographical with some information on Coulter's travels and collections in Mexico; cf. McVaugh 1943.]

CUNNINGHAM, ISABEL SHIPLEY. 1994. *Howard Scott Gentry 1903–1993*. Econ. Bot. 48: 359–381. [A biographical account of the life and career of Gentry, including his extensive work in plant exploration in various parts of the world, especially Mexico. His travels are recounted in detail, as well as his work on germplasm preservation, new crop development, and the systematics of *Agave*. There are three photographs of Gentry and a bibliogra-

phy, which includes many of his publications. Gentry travelled extensively in Mexico and considerable mention is made in this article about his many collecting trips in the country.

CUTAK, LADISLAUS. 1940. *Beyond the beaten path.* Cact. Succ. J. 12(4): 66–70. [An account of a cactus-collecting trip to the vicinity of Monterrey and Saltillo, Mexico.]

DANCE, PETER S. 1986. *A History of Shell Collecting.* Leiden: E. J. Brill, 265 pp + 32 plates. [Contains a brief discussion (p. 148) of a large collection of sea shells made by Frederick Reigen at Mazatlán between 1840 and 1850. Reigen collected several tons of shells at this locality. In 1857 P. P. Carpenter published *The Mazatlán Catalogue* based on the Reigen material.]

DANN, KEVIN. 1986. *A Vermonter discovers the Chihuahuan Desert.* Chihuahuan Desert Disc. 20: 4–7. [A brief account of the plant collections and travels of Cyrus Guernsey Pringle in the Chihuahuan Desert of Mexico; see also Davis (1936).]

DÁVILA A., PATRICIA D., AND MARÍA TERESA GERMÁN R. 1991. *Herbario Nacional de México.* Instituto de Biología, Univ. Autónoma de México, México, D.F., 122 pp. [This description of the National Herbarium of Mexico includes an account of the history of botanical exploration of the country, beginning with the Sessé and Mociño expeditions, especially as these explorations contributed to the development and growth of the herbarium. Donations of specimens received from other institutions and other countries are also noted. Present-day activities in the botanical exploration of various regions of Mexico are described, especially those supported by the National Herbarium.]

DAVIS, HELEN BURNS. 1936. *Life and Work of Cyrus Guernsey Pringle.* Burlington: Univ. Vermont, 756 pp. [A detailed account of Pringle's plant collecting in Mexico with biographical information, diaries, a map showing routes in 23 Mexican states, narratives of some travels, and a list of plants collected. Davis's extensive work on Pringle's travels is supplemented by: F. W. PENNELL, 1937. *Indices of states, places, and railroad routes of Mexico.* Burlington: Univ. Vermont, 14 pp. See also: Dann 1986.]

DAWSON, E[LMER] YALE. 1936. *Cactus collecting in mañana land.* Part I. J. Cact. Succ. Soc. Amer. 7(8): 115–117; Part II. 1936. 7(9): 139–141. [A narrative of a cactus-collecting trip in Baja California; problems of travel and obtaining collecting permits.]

DAWSON, E[LMER] YALE. 1948. *A naturalist's diary on the Mexican West Coast.* Cact. Succ. J. 20: 161–165, 177–180; 21: 26–28, 51–54, 74–78, 99–102. [Narrative of an extensive five-months trip by automobile of Dawson and his wife in 1946 through Baja California and central and western states of mainland Mexico, especially for botanical exploration. They collected cacti, orchids, marine algae, insects, and reptiles, and photographed the vegetation. This is a chatty account, which includes much on the problems of travel and description of vegetation.]

DAWSON, E[LMER] YALE. 1966–1968. *Time of my life.* Cact. Succ. J. (1966) 38: 15–18, 58–60, 95–97, 151–153, 201–203; (1967) 39: 217–220; (1968) 40: 7–9, 60–64, 95–98, 135–138, 202–206. [Narratives of several trips to Mexico, mostly in Baja California, in the 1930's to collect cacti and other succulents. Often accompanied by Howard Gates; includes a considerable amount of information on Gates.]

DIGUET, L[ÉON]. 1895. *Note sur une exploration de la Basse-Californie.* Bull. Mus. Natl. Hist. Nat. Paris 1: 28–30. [Brief account of travels in Baja California, with description of the general ecology of the area.]

DODSON, CAROLYN. 1993. *Botanists of the Mexican–United States Boundary Survey.* Huntia 9(1): 89–96. [After a brief introduction to the establishment and politics of the Boundary Survey, Dodson discusses the activities of the Survey botanists: John Milton Bigelow, Charles C. Parry, George Thurber, and Charles Wright. These botanists collected on both sides of what is now the United States–Mexico border from El Paso, Texas, westward. Publication of the portion of the report of the Survey dealing with plants is also discussed.]

DRUDE, OSCAR. 1878. *Reise der Herren Drs. Bernoulli und R. Cario von Retaluleu in Guatemala nach Comitán in Süd-Mexiko, im Sommer 1877.* Petermanns Geogr. Mitt. 24: 410–413. [Briefly describes the vegetation during a visit to Chiapas.]

DUELLMAN, WILLIAM E. 1961. *The amphibians and reptiles of Michoacán, Mexico.* Univ. Kansas Publ. Mus. Nat. Hist. 15(1): 1–148. [Contains an excellent historical account of the collection and study of Michoacán amphibians and reptiles, including a summary of the author's collecting there with several others.]

DURRELL, GERALD [MALCOLM]. 1972. *Catch Me a Colobus.* New York: Viking Press, 221 pp. [Narrative of a trip to Mexico to collect breeding stock of the threatened Volcano rabbit on Popocatépetl, pp. 172–208.]

DUSHANE, HELEN. 1971. *The Baja California Travels of Charles Russell Orcutt.* Baja California Travel Series No. 23. Los Angeles: Dawson's Book Shop, 75 pp. [The introduction of this book contains a history of natural history studies and travel in Baja California. The main part of the book concerns Orcutt's travels in Baja California to collect mollusks and plants. The first trip was in 1882 with his father, H. C. Orcutt, and the three botanists C. C. Parry, C. G. Pringle, and M. E. Jones. After this he made other trips to collect many specimens of mollusks and plants. Orcutt also collected on the mainland of Mexico. Most of the information on his travels was gleaned from his publications in the *West American Scientist*, a journal published by him. DuShane also presents a brief account of this journal. Knobloch (1979, pp. 49–51) lists some of Orcutt's collecting localities.]

EASTWOOD, ALICE. 1929. *Studies in the flora of Lower California and adjacent islands.* Proc. Calif. Acad. Sci., ser. 4, 18(14): 393–484. [Description of a 1925 expedition of the California Academy of Sciences to the Revillagigedo Islands, exploring Guadalupe, Clarión, Socorro, San Benedicto, Tres Marías, María Madre, María Magdalena, and Isabella islands. Stops were also made along the west coast of Baja. This is a good history of plant collecting on Guadalupe, Cedros, and Tres Marías islands. Eastwood did not accompany the expedition. The plant collecting was done by H. L. Mason.]

EICHLER, AUGUST WILHELM. 1881. *Bericht über die Arbeiten und Veränderungen im Königlichen Botanischen Garten und Botanischen Museum während der Zeit vom 1. April 1878 bis ebendahin 1881.* Jahrb. Königl. Bot. Gart. Berlin 1: 1–164. [Includes a list of collectors of phanerogams by countries; Mexico is covered on p. 162.]

EISEN, GUSTAV. 1895. *Explorations in the Cape Region of Baja California in 1894, with references to former expeditions of the California Academy of Sciences.*

Proc. Calif. Acad. Sci., ser. 2, 5: 733–775. [In August 1894 Eisen and Frank H. Vaslit spent a month collecting in the mountains of the Cape Region, after which they crossed to the mainland where they traveled and collected before returning to San Francisco. A wide variety of organisms was collected, including reptiles, mollusks, insects, and other invertebrate forms. A brief description is given of five previous expeditions sent by the California Academy of Sciences to Baja California.].

EISEN, GUSTAV. 1897. *Explorations in the Cape Region of Baja California made under the auspices of the California Academy of Sciences.* Amer. Geogr. Soc. Bull., New York, 29(3): 271–280. [A more abbreviated account of the same trips discussed earlier by Eisen (1895). Also includes a list of early California Academy of Sciences expeditions and a detailed map.]

EISEN, GUSTAV. 1900. *Explorations in the Central Part of Baja California.* Amer. Geogr. Soc. Bull., New York, 32(5): 397–429 (1907). [Account of 1894 exploration of the central region of Baja California with a listing of places of interest and importance visited north of La Paz. Presents descriptions of climate, watersheds, and general aspects of country. The vegetation and animals found during the trip are discussed as well as distances of sites mentioned from principal towns. This is a good early account of this part of Baja California.]

EMERSON, K[ARY] C[ADMUS] (ed.). 1967. *Carriker on Mallophaga. Posthumous Papers, Catalog of Forms Described as New, and Bibliography. Melbourne A. Carriker, Jr., 1879–1965.* U.S. Natl. Mus. Bull. 248, 150 pp. [Brief biographical information; photograph; bibliography. Carriker collected bird lice extensively in the Neotropical Region, including Mexico. He published several papers on Mexican Mallophaga.]

EMERSON, WILLIAM K. 1958. *Results of the Puritan–American Museum of Natural History expedition to western Mexico. 1. General account.* Amer. Mus. Novit., No. 1894, 25 pp. [Expedition along west coast of Baja California and to Islas Tres Marías, March 5–June 6, 1957; marine and terrestrial specimens collected, with emphasis on studying effects of insular isolation on mammals, reptiles, and amphibians, and comparing present and past distributions of littoral marine invertebrates. Route and collecting localities are mapped. Included also are detailed itineraries and a list of marine collecting stations; photographs.]

EMORY, WILLIAM HEMSLEY. 1857, 1859. *Report on the United States and Mexican Boundary Survey, Made Under the Direction of the Secretary of the Interior, by William H. Emory.* 34th Congr., 1st Sess. Washington. Vol. 1, 258 + 174 pp. Vol. 2, pt. 1, 270 + 78 pp.; pt. 2, 62 + 32 + 85 pp. 346 plates. [This is a major early account of the United States–Mexico border area, including travel accounts, general descriptions of the area, topography, Indian customs, and scientific reports. The latter include: geology and paleontology by James Hall, C. C. Parry, A. Schott, and T. A. Conrad; botany by C. C. Parry, John Torrey, and George Engelmann; mammals, birds, and reptiles by S. F. Baird; and fishes by C. Girard. See JOHN H. JENKINS (1983) *Texas Basic Books*, pp. 144–151, for information on Emory and a more complete assessment of this report, as well as pertinent bibliographic details. A 1987 reprint by the Texas State Historical Association includes a useful introduction to the work by William H. Goetzmann.]

ENGSTRAND, IRIS H. W. 1981. *Spanish Scientists in the New World. The Eighteenth Century Expeditions*. Seattle: Univ. Washington Press, 220 pp. [This is a scholarly study of the Royal Scientific Expedition to New Spain, including information on the travels and work of Sessé and Mociño, Longinos, and Pineda and the Malaspina Expedition. It is an excellent review of scientific exploration of Mexico during the eighteenth century. It is well illustrated and contains an extensive bibliography.]

ERTTER, BARBARA. 1991. *Annetta Mary Carter (1907–1991)*. Fremontia 19(4): 12–14. [Obituary of Baja California plant collector; portrait.]

ESCALANTE P[LIEGO], B. PATRICIA. 1988. *Aves de Nayarit*. Univ. Autó. Nayarit, 141 pp. + 111 illus. [In the section entitled "Expediciones, Recolectores y Estudios Previos," Escalante reviews the collection and study of birds in the State of Nayarit as well as on the Islas Tres Marías from the earliest times. The collections of many early and more recent collectors on these islands and in mainland Nayarit are mentioned.]

ESCALANTE PLIEGO, PATRICIA, ADOLFO G. NAVARRO SIGUENZA, AND A. TOWNSEND PETERSON. 1993. *A geographic, ecological, and historical analysis of land bird diversity in Mexico*, Chapter 8, pp. 281–307, in *Biological Diversity of Mexico: Origins and Distribution.* (T. P. Ramamoorthy, Robert Bye, Antonio Lot, and John Fa, eds.). New York: Oxford Univ. Press, 812 pp. [A concise history of ornithology in Mexico is presented. References are made to many faunal works on birds in Mexico, some of which contain brief historical information on expeditions and bird studies in the country.]

EVANS, HOWARD ENSIGN. 1993. *Pioneer Naturalists. The Discovery and Naming of North American Plants and Animals*. New York: Henry Holt and Co., 294 pp. [Contains brief biographical information on several naturalists who collected in Mexico: William Bullock, Gideon Lincecum, Josiah Gregg, Friedrich A. Wislizenus, Darius N. Couch, Charles C. Parry, John Xántus, Edward Palmer, Edward L. Greene, Edward W. Nelson, Edgar E. Mearns, and Edward A. Goldman. The biographical information is presented in discussions of various taxa of plants and animals whose names (patronyms) commemorate the individuals listed above.]

EWAN, JOSEPH. 1937. *Cantillas Canyon of Lower California: Its geography and botanical history*. Amer. Midl. Nat. 18(3): 351–362. [Ewan reviews the history of botanical exploration of Cantillas Canyon, an elusive locality in northeastern Baja California.]

EWAN, JOSEPH. 1942. *Bibliographical Miscellany–IV. A bibliogeographical guide to the Brandegee botanical collections*. Amer. Midl. Nat. 27(3): 772–789. [Provides biographical information and United States and Mexican plant localities for Townshend S. and Katharine Brandegee.]

EWAN, JOSEPH. 1950. *Rocky Mountain Naturalists*. Denver: Univ. Denver, 358 pp. [Brief sketches are presented for 798 Rocky Mountain naturalists, some of whom also collected in Mexico. Extended biographies are given for C. C. Parry and M. E. Jones, but emphasis is not on their Mexican travels. This is a standard reference for biographies of North American naturalists.]

EWAN, JOSEPH. 1955. *San Francisco as a mecca for nineteenth century naturalists*, pp. 1–63, in *A Century of Progress in the Natural Sciences 1853–1953*. San Francisco: California Acad. Sci., 807 pp. [Many of the naturalists mentioned by Ewan as being in some way associated with San Francisco,

California, also traveled and worked in Mexico. The roster of biographies contains references to biographical information on many of these.]

EWAN, JOSEPH. 1971. *Ynés Enriquetta Julietta Mexia*, pp. 533–534, in *Notable American Women—A Biographical Dictionary* (E. T. James, J. W. James, and P. S. Boyer, eds.), Cambridge: Harvard Univ. Press, vol. 2, 659 pp. [Biobibliographical; contains brief information on Mexia's Mexican travels.]

EWAN, JOSEPH, AND NESTA DUNN EWAN. 1981. *Biographical Dictionary of Rocky Mountain Naturalists. A Guide to the Writings and Collections of Botanists, Zoologists, Geologists, Artists, and Photographers 1682–1932.* Boston: Dr. W. Junk, Publ., The Hague, 253 pp. [Additions and corrections to the biographical roster portion of Ewan (1950), increasing the number of naturalists covered by about 33%.]

EWING, EVA C. 1965. *Down Baja by mule.* Pacific Disc. 27(4): 21–26. [An interesting account of a mule trip of several months down the length of Baja California. Botanist Reid Moran collected plants while accompanying the expedition part of the way. Map of the route and numerous photographs included.]

FITZ MAURICE, BETTY. 1990. *A tribute to Mexico's first lady of cactus.* Cact. Succ. J. 62: 141–143. [Concerns Helia Bravo-Hollis and her contributions to the knowledge of Cactaceae in Mexico; with portrait.]

FITZ MAURICE, W. A. 1990. *Cruising in the Mar de Cortez.* Cact. Succ. J. 62(2): 88–90. [Travel by land and sea to collect and observe cacti; photographs.]

FLORES VILLELA, OSCAR, AND ADRIAN NIETO M. 1989. *La taxonomía herpetológica en México; un análisis breve.* Ciencias, Spec. No. 13: 103–112. [A brief historical analysis of herpetology in Mexico.]

FONVIELLE, WILFRED DE. 1861, 1862. *Explorations botaniques au Mexique.* Rev. Hort. 1861: 414–416; 1862: 39–40, 98–99, 118, 179–180. [An interesting extended account of Benedict Roezl's travels and plant collecting in south-central Mexico.]

FREY, G. 1959. *Meine entomologische Reise nach Mexiko und Guatemala.* Entomol. Arb. Mus. G. Frey 10: 597–604. [Account of a trip October–December, 1958; Frey entered Mexico at Nogales, then travelled to Guaymas, Los Mochis, Mazatlán, Guadalajara, Morelia, Acapulco, Puebla, Veracruz, and Mérida, to collect Coleoptera.]

FRYXELL, PAUL A[RNOLD]. 1988. *Malvaceae of Mexico.* Syst. Bot. Monogr. 25: 1–522. [Provides a brief list of itineraries and biographies of important collectors of Mexican plants, pp. 468–470.]

FULTON, MAURICE GARLAND (ed.). 1941, 1944. *Diaries and Letters of Josiah Gregg.* Norman: Univ. Oklahoma Press, vol. 1, *Southwestern Enterprises, 1840–1847,* 413 pp.; vol. 2, *Excursions in Mexico and California, 1847–1850,* 396 pp. [Gregg's diaries, letters and field notes with detailed itineraries and localities of plant collections in northern Mexico are presented here. Many of his letters were written to George Engelmann and deal with botanical matters. Extensive collections of plants and animals were made in northern Mexico during his tenure of medical practice at Saltillo. Some of the plants were sent to Engelmann and some to other correspondents. Gregg also visited Mexico City and western Mexico before departing to California. This is an excellent account of Mexico in the mid-19th century with considerable information on the natural history of the country. Gregg died in the California goldfields in 1850 at the age of 44. See: Mitich and

Kyser (1990) for a brief but informative biography of Gregg and discussion of his travels.]

GADOW, HANS. 1908. *Through Southern Mexico, Being an Account of the Travels of a Naturalist.* London: Witherby & Co., 527 pp. [Narrative of travel based on two trips, June–September, 1902, and in 1904, totalling eight months, from Mexico City to the Isthmus of Tehuantepec. The purpose of the travel was to study plant and animal distribution in relation to environmental conditions. This book is strong on vertebrate collecting, especially lizards.]

GÁNDARA, GUILLERMO. 1936. *Historia de la enseñanza de las ciencias biológicas en el México Nacional y Prenacional.* Mem. Acad. Nac. Cienc. "Antonio Alzate" 53: 387–410. [A history of the biological sciences in Mexico from pre-Columbian times to the 1930's. Discusses briefly the major resident contributors to the study of plants and animals in Mexico.]

GARDNER, ERLE STANLEY. 1948. *The Land of Shorter Shadows.* New York: William Morrow Co., 228 pp. [A Baja California travelogue with some natural history emphasis. Some collecting was done. Gardner wrote other travel books about Baja, but these are only marginally of natural history interest. One of the latter, entitled *Hunting the Desert Whale* (1960, William Morrow Co., 208 pp.), is an account of observing and photographing whales in Scammon's Lagoon. Another, *Hovering Over Baja* (1961, William Morrow Co., 240 pp.), provides descriptions of some remote canyons of Baja California that were explored by use of a helicopter.]

GATES, HOWARD E. 1934. *Collecting in Lower California, Mexico.* Cact. Succ. J. 5(8): 526–527. [Description of a trip of 13 weeks to Baja California to collect cacti. The author does not say much about cacti but does dwell at length on the automobile troubles during the trip. All of the horrors of automobile travel in Baja before the improvement of the major highways are wrapped up in this article.]

GATES, HOWARD E. 1952. *Mexico.* Cact. Succ. J. 24: 85–87, 103–105, 128. [Narrative of cactus trip in October and November, 1951, from El Paso, Texas, south to Mexico City, Pueblo, Tehuacán, Veracruz, Orizaba, and up the western coast to Mazatlán and Durango. Description of the country, vegetation, people, and problems with travel.]

GATES, HOWARD E. 1953, 1954. *More about Mexico.* Cact. Succ. J. (1953) 25: 86–88, 112–113, 146–147, 175–177; (1954) 26: 14–16, 57–59. [Account of travel (with E. Yale Dawson) in Mexico to collect and observe cacti during May and June, 1952. They covered a large area of the Mexican Central Plateau, the lowland areas of southern Mexico, and the West Coast.]

GAY, ED, AND BETTY GAY. 1960, 1961. *High center.* (1960). Cact. Succ. J. 32(6): 176–179; (1961) 33(1): 3–7. [A trip the length of Baja California to collect and observe cacti; the difficulty of automobile travel is discussed; photographs.]

GAY, ED, AND BETTY GAY. 1961. *A cactophile's tour of Mexico.* Cact. Succ. J. 33: 154–158, 163–167. [Tour of the Central Plateau of Mexico observing cacti; photographs.]

GEISER, SAMUEL WOOD. 1948. *Naturalists of the Frontier.* 2nd ed. (revised and enlarged). Dallas: Southern Methodist Univ. Press, 296 pp. [Geiser presents extended biographies of several early naturalists of Texas, some of whom (Jean Louis Berlandier, Louis Cachand Ervendberg, Charles Wright, and Gideon Lincecum) traveled and collected in Mexico. Some letters

written during 1856–1860 by Ervendberg to Asa Gray from Mexico are included. Little is known of Ervendberg's collections in Mexico, although he lived there during the last eight years of his life. Geiser also includes a roster of many other naturalists who worked in Texas and several who collected in Mexico.]

GENTRY, HOWARD SCOTT. 1942. *Río Mayo Plants. A Study of the Flora and Vegetation of the Valley of the Rio Mayo, Sonora.* Carnegie Inst. Washington Publ. 527, 328 pp. [This book includes an extensive vegetation analysis of the area and a list and description of the localities where Gentry collected. The collecting took place during the period October, 1934–November, 1939, representing about 27 months of field work. Gentry's routes are mapped. Numerous photographs are included.]

GENTRY, HOWARD SCOTT. 1946a. *Sierra Tacuichamona—a Sinaloa plant locale.* Bull. Torrey Bot. Club 73: 356–362. [An account of the author's plant-collecting trips into the Sierra Tacuichamona (SSE of Culiacán) and Cerro Colorado (E of Ymalá), including a map showing his pack mule routes and detailed descriptions of the vegetation.]

GENTRY, HOWARD SCOTT. 1946b. *Notes on the vegetation of Sierra Surotato in northern Sinaloa.* Bull. Torrey Bot. Club 73: 451–462. [An account of the author's travels through the Sierra by pack mule, with a map of the area, photographs, and detailed vegetational descriptions of several of the localities visited.]

GILBERT, PAMELA. 1977. *A Compendium of the Biographical Literature on Deceased Entomologists.* London: British Museum (Natural History), 453 pp. [List of obituaries and biographies of about 7,500 entomologists, many of whom collected in Mexico. This work should be supplemented by: GAEDIKE, REINHARD. 1985. *Berichtigungen und Ergänzungen zu P. Gilbert: A compendium of the biographical literature on deceased entomologists.* Beiträg. Entomol., Berlin 35: 369–408. Gaedike provides a large number of additions and corrections to Gilbert's list.]

GLASS, CHARLES. 1992. *Mexico logbook, Vol. II.* Cact. Succ. J. 64(6): 311–316. [Itinerary of a trip to the state of Guanajuato in search of cacti, December, 1991–January, 1992; photographs.]

GLASS, CHARLES, AND ROBERT [A.] FOSTER. 1970–1972. *Mexico logbook.* Cact. Succ. J. (1970) 42: 73–77, 107–112, 174–178, 229–233, 263–269; (1971) 43: 3–7, 70–76, 119–121, 143–146, 197–203, 268–273; (1972) 44: 95–98, 136, 168–172, 198–203, 236. [Travel account of a seven-week trip thoughout Mexico in 1968 to collect cacti; covered 21 states and traveled 8600 miles; description of the country and the cacti encountered; many photographs.]

GLASS, CHARLES, AND ROBERT A. FOSTER. 1983, 1984. *Mexican logbook. Texas-Jaumave Dolichothele expedition (February 21–March 6, 1968.).* Cact. Succ. J. (1983) 55: 266–271; (1984) 56: 16–19. [Itinerary and list of collections; many photographs.]

GLASS, CHARLES, AND ROBERT A. FOSTER. 1984. *Mexican logbook.* Cact. Succ. J. 56: 60–63. [Itinerary and list of collections of a short trip to Sonora in 1969.]

GLASS, CHARLES, AND ROBERT A. FOSTER. 1984, 1985. *Mexican logbook. Mexico–Cuernavaca Expedition, Oct. 4–Nov. 12, 1969.* Cact. Succ. J. (1984) 56: 118–121, 152–157, 223–232, 268–269; (1985) 57: 66–69, 118–120. [Itinerary and collection numbers of cacti; photographs.]

GLASS, CHARLES, AND ROBERT A. FOSTER. 1985, 1986. *Mexican logbook. Abbey Gardens Spring Expedition 1970: April 11th–May 19th.* (1985), Cact. Succ. J. 57: 148–155, 220–225; (1986) 58: 60–63. [Western (Sonora) and north-central Mexico (Torreón, Saltillo, and Nuevo León); itinerary, list of cacti, and photographs.]

GODMAN, FREDERICH DUCANE. 1915. *Introductory volume, Zoology, Botany and Archeology,* in *Biologia Centrali-Americana*, vol. 1, 149 pp. + maps I–VIII (Godman, F. D., and O. Salvin, eds.). [This is a general introduction to the initiation and publication of the *Biologia Centrali-Americana.* There is a list of the completed volumes with an analysis and summary of the contents of each. The origin of the flora and fauna of Central America (including Mexico) is discussed. Godman also described his travels in Mexico and mentions several collectors, including A. Boucard, G. F. Gaumer, and H. H. Smith, among others. The physical features of Mexico are described on pp. 14–24.]

GOLD, DUDLEY B., AND H. SÁNCHEZ MEJORADA. 1956. *Un recorrido por el estado de Sonora.* Cact. Succ. Mex. 1(3): 45–50. [Discussion of species of cacti encountered at the many localities visited in Sonora; photographs.]

GOLD, DUDLEY B., AND H. SÁNCHEZ MEJORADA. 1962. *Excursión de Tecamachalco a Acultzingo.* Cact. Succ. Mex. 7(4): 96–99. [Details of a cactus-collecting trip in Puebla and Veracruz; photographs.]

GOLDMAN, EDWARD A[LPHONSO]. 1916. *Plant records of an expedition to Lower California.* U.S. Natl. Mus. 16(14): 309–371. [A brief review of the history of the botanical exploration Baja California and maps of the route traveled by the author and E. W. Nelson; includes many photographs of plants.]

GOLDMAN, EDWARD A[LPHONSO]. 1935. *Edward William Nelson—Naturalist, 1855–1934.* Auk 52(2): 135–148. [An extended biographical account of Nelson and his many contributions to natural history, including extensive collections in Mexico.]

GOLDMAN, EDWARD ALPHONSO. 1951. *Biological Investigations in Mexico.* Smithsonian Misc. Coll. 115: 1–476. [This important publication on Mexican natural history presents the results of exploration and travel narratives of Goldman and E. W. Nelson in Mexico from 1896 to 1906. Extensive collections were made, including 17,400 specimens of mammals, 12,400 of birds, and over 7,000 of plants. Every Mexican state was visited. A map showing their routes is included, as is an extended and detailed gazetteer of localities visited. The major part of the text includes descriptions of the areas they visited and some travel narratives. Much is written about the biogeographical relationships of various areas in Mexico. This work was undertaken by the Bureau of Biological Survey of the U.S. Department of Agriculture. A prefatory note by Hartley H. T. Jackson sets the background for the studies and explains how the present volume came to be written. See also: Nelson (1922) and Sterling (1991).]

GÓMEZ-POMPA, ARTURO, ET AL. 1969. *Homenaje a Faustino Miranda.* Bol. Soc. Bot. Méx. 30: 1–22. [A collection of remembrances of the life and work of the Mexican botanist Miranda (1905–1964) in connection with a ceremony held in his memory on February 19, 1965; portrait. Authors of the various articles are Efrén C. Del Pozo, Arturo Gómez-Pompa, Efraím Hernández X., Manuel Ruiz Oronoz, and Javier Valdés G. See also: Rzedowski (1966, 1967).]

González Ortega, Jesús. 1927. *Exploración biológica por la Cuenca del Río Tamazula*. Mem. Soc. Cient. "Antonio Alzate" 47(1–4): 145–152. [This reprinted in González (1929).]

González Ortega, Jesús. 1929. *Exploración biológica a la cuenca del Río Tamazula 6 a 26 de febrero de 1926*. Bol. Pro-Cultura Regional, S. Cl. 1(2): 14–16; 1(3): 1–4. [Contains a description of explorations of the Río Tamazula watershed, principally in the state of Durango. Includes also geographical and climatological data with list of flora by altitudinal zones and mammals and birds observed; map of areas explored.]

Goodman, G. G. 1969. *Mammals from the state of Oaxaca, Mexico, in the American Museum of Natural History*. Bull. Amer. Mus. Nat. Hist. 141: 1–296. [Based principally on the botanical and zoological collections of Thomas B. MacDougall, with a gazetteer of collecting localities on pp. 256–265.]

Gould, Frank W[alton], and Reid [Venable] Moran. 1981. *The grasses of Baja California*. Mem. San Diego Soc. Nat. Hist. 12: 1–140. ["Collectors" on pp. 8–9, including G. W. Barclay, T. S. Brandegee, E. Palmer, C. R. Orcutt, C. A. Purpus, M. E. Jones, I. L. Wiggins, A. M. Carter, R. V. Moran, and others.]

Gray, Asa. 1855. *Plantae Novae Thurberianae: The characters of some new genera and species of plants in a collection made by George Thurber, Esq., of the late Mexican Boundary Commission, chiefly in New Mexico and Sonora*. Mem. Amer. Acad. Arts Sci. 5: 297–328. [Contains travel notes by George Thurber in New Mexico and Sonora.]

Gray, Asa. 1861. *A cursory examination of a collection of dried plants made by L. C. Ervendberg around Wartenberg, near Tantoyuca in the ancient province of Huasteca, Mexico, in 1858 and 1859*. Proc. Amer. Acad. Arts Sci. 5: 174–190. [See Geiser (1948) for additional information on Ervendberg.]

Grigsby, David. 1983. *Mexico logbook 1978 expedition to Central Mexico (Nov. 25 through Dec. 9th.)*. Cact. Succ. J. 55: 56–60, 108–112, 165–170. [Account of collecting and observing cacti and other plants over most of the major cactus areas of central Mexico; many photographs.]

Griscom, Ludlow. 1934. *The ornithology of Guerrero, Mexico*. Bull. Mus. Comp. Zool. 75(10): 367–422. [A brief history of study and collecting in the State of Guerrero. An itinerary of W. W. Brown relating to his collections in Guerrero during the period 1930–1932 is also included.]

Guzmán Huerta, Gastón. 1958. *Los aspectos biológicas de la exploración en el Territorio de Baja California*. Bol. Soc. Mex. Geogr. Estad. 88(1–3): 197–275. [An exploration of the southern part of Baja California was carried out under the auspices of the Sociedad Mexicana de Geografía y Estadística. An itinerary and an accounting of the botanical and zoological specimens collected are given. There are extended sections on the biotic and vegetational zones and one on the useful plants of the territory. Part 6 treats the fauna of the region and part 7 the renewable resources. Includes also a map of the vegetation zones and many photographs.]

Hanna, G. Dallas. 1925. *Expedition to Guadalupe Island, Mexico, in 1922. General Report.* Proc. Calif. Acad. Sci., ser. 4, 14(12): 217–275. [Narrative of joint United States–Mexico expedition on the Mexican ship *Tecate*, July 9–August 16, 1922, to make natural history observations and collections on several islands off the west coast of Baja California. Several groups of terrestrial and marine vertebrates and invertebrates were collected along with fossils and plants. An itinerary is provided.]

HANNA, G. DALLAS. 1926. *Expedition to the Revillagigedo Islands, México, in 1925. General report.* Proc. Calif. Acad. Sci., ser. 4, 15(1): 1–113. [A detailed narrative account of an expedition, April 15–June 12, 1925, to the four islands of the Revillagigedo group to conduct field work on the flora and fauna. The major plant and animal groups were covered by the American and Mexican naturalists of the expedition. The paper contains maps and is well illustrated with photographs.]

HANNA, G. DALLAS, AND A. W. ANTHONY. 1923. *A cruise among desert islands.* Natl. Geogr. Mag. 44: 71–99. [A popularized account of an expedition on the Mexican fisheries boat *Tecate* to study the flora and fauna of islands off the west coast of Baja California; photographs. See Hanna (1925) for a more detailed account of the trip.]

HARBISON, CHARLES F. 1950. *Rediscovery of the lost species of cactus, Pachycereus orcuttii (K. Brandegee).* Cact. Succ. J. 22(4): 99- 105. [Account of several trips to Baja California to hunt for this cactus. The author and Curtis M. Brown (a lepidopterist) went as far south as Arroyo del Rosarito during the latter part of March and early April, 1935. In March, 1938, he made another trip with Allan G. Stover. A December, 1949, trip was taken to the El Rosario area.]

HARDY, R[OBERT] W[ILLIAM] H[ALE]. 1977. *Travels in the Interior of Mexico in Baja California and Around the Sea of Cortes, in 1825, 1826, 1827, & 1828.* Glorieta, New Mexico: The Rio Grande Press, Inc., 558 pp. [The rare first edition of this work was published in 1829. The Rio Grande Press edition cited here is apparently the only subsequent printing of the book. Although not primarily natural history in scope, this account of early travels in Sonora, Chihuahua, and the Gulf of California, mentions some of the more prominent plants and animals encountered. This is the first comprehensive account of the area published in English. Includes a useful introduction by David J. Weber and a preface by Robert B. McCoy. There is also a new index to the whole work and a map of the author's route.]

HARTWEG, THEODOR. 1841. [*An account of his mission.*] Trans. Roy. Hort. Soc. London, ser. 2, 2: 373–409. [Botanical travels, Veracruz to Michoacán to Oaxaca.]

HARTWEG, THEODOR. 1843. [*An account of his mission in Mexico and Guatemala.*] Trans. Roy. Hort. Soc. London, ser. 2, 3: 115–134. [Veracruz to Michoacán and Zacatecas to Oaxaca.]

HAWKES, J[OHN] G[REGORY]. 1941. *Potato collecting expeditions in Mexico and South America.* Bull. Imp. Bur. Pl. Breed. Gen., 30 pp. [Provides an itinerary of E. K. Balls in Mexico in 1938 to collect potatoes for breeding programs. From March 19 to October 31, 1938, Balls and companions, N. Balls and W. B. Gourlay, collected potatoes at high elevations in the mountains to the west, south, and east of Mexico City. A map of the collection area is provided, as is a list of localities and elevations at which collections were made.]

HEALY, B. J. 1975. *The Plant Hunters.* New York: Charles Scribner's Sons, 214 pp. [One of several "plant hunter" books that have been published in recent years. In the chapter "Treasure lands of America," Healy discusses the activities of several of the notable plant collectors in Mexico.]

HEDGPETH, JOEL W. (ed.). 1978. *The Outer Shores, pt. 2.* Eureka, California: Mad River Press, Inc., 182 pp. [Contains much detailed information from Ed

Rickett's notebooks on the travel of John Steinbeck and Ricketts to Baja California and the Gulf of California on the *Western Flyer* to collect marine invertebrates. Some of this information was used by Steinbeck and Ricketts (1941) in writing the *Sea of Cortez*.]

HEID, GRAHAM. 1942. *To Hamilton's ranch for cacti.* Cact. Succ. J. [Collecting trip to Hamilton Ranch "about 180 miles south of Tijuana" in northern Baja California.]

HEMSLEY, W[ILLIAM] B[OTTING]. 1887. *A sketch of the history of botanical exploration of Mexico and Central America*, in *Biologia Centrali-Americana, Bot.* 4: 117–137 (Godman, F. D., and O. Salvin, eds.). [An excellent review of the early expeditions and plant collectors in Mexico; considerable biographical information is presented. There is a Spanish translation by José Ramírez in: Naturaleza, ser. 2, 1: 1–15, 1887–1890.]

HERNÁNDEZ XOLOCOTZI, EFRAÍM. 1947. *Eizi Matuda y la flora de Chiapas*. Bol. Soc. Bot. Méx. 5: 1–3. [A biographical sketch of Matuda, an important and prolific resident collector of plants of Chiapas; portrait.]

HIGGINS, ETHEL PHOEBE BAILEY. 1959. *Type localities of vascular plants in San Diego County, California*. Trans. San Diego Soc. Nat. Hist. 12: 347–406. [Includes a section on collectors (pp. 388–399) with references to many who collected in Mexico.]

HIGUERAS, MARÍA DOLORES (ed.) 1989. *La Botánica en la Expedición Malaspina (1789–1794).* Real Jardín Botánico de Madrid. Colección Encuentros Turner, 218 pp. [Detailed account, including the collecting activities of Thaddeus Haenke and Luis Née, with a dozen chapters by various authors; profusely illustrated, including color reproductions of botanical plates (fully catalogued), photographs of type specimens, portraits of Haenke and an account of biographical materials on Haenke in Czechoslovakian archives, biographical materials on the life and work of Née, and a listing of Haenke documents in Madrid.]

HINTON, JAMES, AND J[ERZY] RZEDOWSKI. 1972. *George B. Hinton, collector of plants in southwestern Mexico*. J. Arnold Arbor. 53: 141–181. [This is the English version of Hinton and Rzedowski (1975). The 1975 index to identified taxa collected by Hinton is not included here. There is a table of Hinton's collecting localities that contains considerable information on coordinates, altitudes, roads, and predominant forest vegetation; this table is not included in the 1975 paper.]

HINTON, JAIME, AND J[ERZY] RZEDOWSKI. 1975. *George B. Hinton, explorador botánico en el sudoeste de México*. Anal. Esc. Nac. Cienc. Biol. 21: 1–114. [A fascinating narrative account of G. B. Hinton and his plant-collecting expeditions during 1931–1944 in remote areas of the states of Guerrero, Michoacán, and México. The main text portion is the same as in the 1972 paper. Included also is a partial list of new taxa based on Hinton's collections, a partial list of identified taxa collected by Hinton, and a map of his collecting localities.]

HITCHCOCK, A[LBERT] [SPEAR]. 1919. *A botanical trip to Mexico. I.* Sci. Monthly 8(2): 129–145; *II,* 8(3): 216–238. [Hitchcock describes a 1910 trip to Mexico to investigate forage conditions and to collect grasses. Travel took place in nearly all of the states north of the Isthmus of Tehuantepec. The topography, climate, vegetation (especially grasses), and range conditions are described. Some of the early plant collectors, such as F. M. Liebmann,

C. C. W. Sartorius, F. Deppe, C. J. W. Schiede, M. Botteri, H. G. Galeotti, and others, are briefly mentioned. This is not a travel narrative, but an itinerary is included with a list of localities where plants were collected. The article is profusely illustrated with photographs.]

HOLLAND, W[ILLIAM] J[ACOB]. 1919. *Herbert Huntingdon Smith*. Entomol. News 30(8): 211–214. [Biographical; portrait. Smith's Mexican collections were used in publication of the *Biologia Centrali-Americana*.]

HOAG, M. E. 1908. *Collecting in Mexico*. Entomol. News 14: 319–322. [Collected mostly Lepidoptera at Altamira, Tampico, San Luis Potosí, Saltillo, and Concepción del Oro.]

HORNADAY, WILLIAM TEMPLE. 1908. *Camp-Fires on Desert and Lava*. New York: Charles Scribner's Sons, 362 pp. [A highly readable account of Hornaday's travels in Sonora and Arizona in 1907 and exploration of the Pinacate Mountain region in northwestern Sonora. The routes of travel are mapped. Much is presented on plants and animals encountered during the travels. The University of Arizona Press issued a reprint of this work in 1983 with a new introduction by B. L. Fontana. The latter is very useful as an assessment of the book 75 years later and as a source of information on various people and events mentioned in the travel account.]

HOWARD, L[ELAND] O[SSIAN]. 1930. *A History of Applied Entomology (Somewhat Anecdotal)*. Washington, D.C.: Smithsonian Institution, Smithsonian Misc. Coll., vol. 84, 564 pp. [A monumental contribution to the history of entomology of the world. Although primarily developing the history of applied entomology, there is much of interest to the naturalist. Accounts of visits by the author to Mexico in 1898, 1902, and 1904 include mention of the work of Mexican entomologists, for example, A. Dugès, A. L. Herrera, and A. Dampf, and outlets available at that time for publication of scientific work in Mexico. Many portraits are included, including those of Dugès, Herrera, and Dampf.]

HOWARD, L[ELAND] O[SSIAN], H[ERBERT] S[PENCER] BARBER, AND AUGUST BUSCK. 1928. *Dr. E. A. Schwarz* [Obituary]. Proc. Entomol. Soc. Washington 30(9): 153–183. [A detailed biography of the entomologist E. A. Schwarz, including a map showing localities where he collected in northern Mexico in 1909. A list of Schwarz's 395 publications and scientific notes is also included. Some of his correspondence was published in 1929 as "Letters of E. A. Schwarz" (J. New York Entomol. Soc. 37: 181–394, John D. Sherman, Jr., ed.); however, none of these relates to collecting and travelling in Mexico.]

HOWDEN, HENRY F[ULLER]. 1966. *Entomological ramblings in Mexico*. Coleopt. Bull. 20(1): 19–26. [Howden describes insect-collecting localities visited in central and northern Mexico during the period 1958–1964.]

HOWELL, JOHN THOMAS (ed.). 1965. *Botanical exploration of Marcus E. Jones, 1876–1991: an autobiographical account*. Leafl. W. Bot. 10(2): 193–236. [A diary of Jones' collecting trips with localities and plant numbers for the years 1876–1919. Some of the entries for the years 1882, 1892, and 1903 pertain to travels in Mexico. Additional collecting was done in Mexico by Jones after 1919. A gazetteer of Jones' plant exploration is included; cf. Lenz (1986).]

HUEY, LAURENCE M. 1964. *The mammals of Baja California*. Trans. San Diego Soc. Nat. Hist. 13(7): 85–168. [On pp. 88–90 the author reviews his own

field work in Baja California as well as that of others who collected and studied mammals there during the period 1914–1958.]

HUME, EDGAR ERSKINE. 1942. *Ornithologists of the United States Army Medical Corps*. Baltimore: John Hopkins Press, 583 pp. [Contains biographies of 36 members of the early U.S. Medical Corps who collected and studied birds. At least two of these, E. A. Mearns and John Xántus, collected in Mexico. Others, for example, Richard Potts (1828–1866) and Samuel Wylie Crawford (1827–1892), traveled in Mexico and/or in the Mexico–United States border area and probably collected there.]

INDA, JULIO RIQUELME. 1961. *Los naturalistas desaparecidos de 1936 a 1961*. Rev. Soc. Mex. Hist. Nat. 22: 243–276. [General history of Mexican naturalists who died between 1936 and 1961. Brief biographical accounts of geologists, zoologists, and botanists, and the nature of their publications. Some photographs. No information on travel is provided.]

JACKSON, DONALD DALE, AND PETER WOOD. 1977. *The Sierra Madre*. Alexandria, Virginia: The American Wilderness/Time-Life Books, rev. ed., 184 pp. [This book includes accounts of travel and interpretation of the geography and natural history of the Sierra Madre Occidental and Sierra Madre Oriental of northcentral Mexico. It is extensively illustrated with photographs.]

JAEGER, EDMUND C[ARROLL]. 1959. *To Baja California with a naturalist*. Desert Mag. 28: 14–16. [A popularized account of a trip to Baja California from San Felipe south along the east coast of the peninsula. Descriptions are given of the topography and plants encountered; photographs. There is no mention of collections being made. See: EWAN, JOSEPH, 1987. *Edmund Carroll Jaeger (1887–1983), Dave Keck's California mentor*. Taxon 36(2): 402–404, for brief biographical information on Jaeger and his desert work.]

JANOVY, JOHN, JR. 1992. *Vermilion Sea. A Naturalist's Journey in Baja California*. Boston: Houghton Mifflin Co., 226 pp. [If for no other reason, the title of this book qualifies it for inclusion in this bibliography. This is not the usual naturalist's travelogue. According to the author, it was written as an "intellectual field trip." The life and land of Baja California are used as a background to address larger issues of the natural and man-made world.]

JEPSON, WILLIS L. 1897. *The explorations of Hartweg in America*. Erythea 5: 31–35, 51–56. [Biographical sketch and rough itinerary from Veracruz to Durango, south to Michoacán and Oaxaca; subsequently in Guatemala and California.]

JEPSON, WILLIS L. 1929. *Charles Russell Orcutt*. Madroño 1: 273–274. [Biographical account.]

JEPSON, WILLIS L. 1934. *Marcus Eugene Jones*. Madroño 2: 152–154. [Biographical account.]

JOHNSON, JOAN. 1969. *Yucatan trip*. Cact. Succ. J. 41: 83–85. [Winter trip to Yucatan, and cacti observed and collected].

JOHNSON, MABEL. 1961. *Our Mexican diary*. Cact. Succ. J. 32: 57–59, 80–86. [A travelogue of a trip in 1960 to Mexico City and vicinity as part of business of the Cactus and Succulent Society of America. Frequent mention is made of cacti and other succulents encountered.]

JOHNSON, PAUL, AND JOAN JOHNSON. 1982. *Dudley Gold, my friend*. Cact. Succ. J. 54: 157. [About the life of Gold, who collected cacti extensively in Mexico.]

JOHNSTON, EDITH DUNCAN. 1941. *Doctor William Houstoun, botanist*. Georgia Hist. Quart. 25(4): 325–339. [Relatively little of this publication deals with Mexico per se, but Houstoun collected in the country in 1731 and the included

biographical information is of interest. Virtually the same account was later published by Johnston in the *Houstouns of Georgia* (1950, Univ. Georgia Press, 430 pp.).]

JOHNSTON, I[VAN] M[URRAY]. 1924. *Expedition of the California Academy of Sciences to the Gulf of California in 1921.* Proc. Calif. Acad. Sci. 4(12): 951–1218. [Contains history of botanical exploration of the area.]

JOHNSTON, I[VAN] M[URRAY]. 1931. *The flora of the Revillagigedo Islands.* Proc. Calif. Acad. Sci. 4(20): 9–104. [Contains history of botanical exploration of the islands.]

JONES, MARCUS E[UGENE]. 1935. *Field notes of Mexican trip, 1930.* Contr. West. Bot., No. 18, pp. 86–119. [Narrative of travel in Baja California and mainland Mexico, September–December, 1930. Mostly botanical in nature.]

JONES, RODNEY WILSON. 1943. *A journey to the First International Orchid Congress and orchid collecting in Mexico.* Amer. Orchid Soc. Bull. 12: 3–7, 45–52, 87–97, 115–119, 145–146, 170–171. [A rambling account of attendance at the Orchid Congress, visiting orchidologists' collections en route, and travels through Mexico for the purpose of collecting orchids. There are many photographs and, of particular interest, a map (pp. 170–171) of Mexico showing the routes taken—pretty much following the Pan American Highway to Tuxtla Gutiérrez, Chiapas, to the site of the Congress.]

KAVANAUGH, DAVID H., AND PAUL H. ARNAUD, JR. 1981. *Hugh Bosdin Leech—A curator's curator.* Pan-Pac. Entomol. 57(1): 2–42. [Biographical; portrait; list of publications.]

KEIFFER, H[ARTFORD] H. 1925, 1926. [*California Academy of Sciences Expedition to the Revillagigedo Islands, Mexico, in 1925*] Proc. Pacific Coast Entomol. Soc. 2(5): 67–69. [Keiffer describes travel and insect collecting on Guadalupe, Clarión, Socorro, San Benedicto, Isabella, Cedros, María Madre, and San Martín islands. A brief description of the vegetation and climatic conditions is also presented. Over 10,000 insect specimens were collected.]

KELLNER, L. 1963. *Alexander von Humboldt.* New York: Oxford Univ. Press, 247 pp. [Includes section on Humboldt's travels in Mexico.]

KELLOGG, REMINGTON. 1932. *Mexican tailless amphibians in the United States National Museum.* Bull. U.S. Natl. Mus. 160, 224 pp. [An excellent historical review of many collectors of amphibians in Mexico is presented on pp. 1–14.]

KIMNACH, MYRON. 1964, 1965. *Through the land of cacti.* Cact. Succ. J. (1964) 36: 3–6, 44–46, 65–70, 130–134, 181–184; (1965) 52–56, 87–90, 116–117, 150–154. [Travel account of extensive six-weeks expedition to Mexico in 1959, accompanied by Reid Moran; covered most of the cactus area of mainland Mexico; photographs.]

KNOBLOCH, IRVING W[ILLIAM]. 1960. *Hunting ferns in the barrancas of Chihuahua, Mexico.* Amer. Fern J. 50(2): 161–168. [Knobloch describes various trips made in the 1950's to fern-collecting sites in northern Chihuahua. The vegetation and topography, and roads and accommodations available at that time are also briefly described.]

KNOBLOCH, IRVING W[ILLIAM]. 1979. *The Plant Collectors of Northern Mexico.* Latin American Studies Center, Michigan State Univ., Monogr. Ser. no. 17, 98 pp. [Nearly 300 plant collectors in northern Mexico are listed with some biographical information, localities where collections were made, and where their specimens are housed. This compilation is useful because much of the information was obtained directly from the collectors through correspondence and other communications.]

KNOBLOCH, IRVING W[ILLIAM]. 1983. *A Preliminary Verified List of Plant Collectors in Mexico*. Phytologia, Mem. 6: 1–179. [About three thousand persons who collected plants in Mexico are listed with references to publications in which their specimens were treated and to herbaria in which specimens are deposited. There is an extensive bibliography.]

KOEHLER, H[ERMAN]. 1904. *Alexander von Humboldt in Mexico*. Prometheus 15: 469–471. [Brief review of Humboldt's travels in Mexico.]

KRES, JOSEPH, AND LUCIA KRES. 1960. *A report on a trip to Mexico*. Cact. Succ. J. 32: 85–88, 112–115. [Account of a cactus-collecting trip to Mexico, from Laredo to Monterrey, Saltillo, Mexico City, back north through Ciudad Valles; photographs.]

KRUTCH, JOSEPH WOOD. 1961. *The Forgotten Peninsula. A Naturalist in Baja California*. New York: William Sloane Associates, 277 pp. [This classic of nature writing is both an interesting travelogue and a sensitive description of the land and its inhabitants. It was reprinted in 1986 by the University of Arizona Press with a new foreword by Ann Zwinger.]

KÜHNEL, JOSEF. 1960. *Thaddeus Haenke, Leben und Wirken eines Forschers*. München: Verlag Robert Lerche, 277 pp., 3 maps. [An extensive study of Haenke, including his travels with the Malaspina Expedition, some of which took place in Mexico; portraits; maps of travels. According to Stafleu and Cowan (1976–1988), this is the major modern biography of Haenke. It is based on considerable original material.]

LANGMAN, IDA K[APLAN]. 1949. *Dos figuras casi olvidadas en la historia de la botánica mexicana*. Rev. Soc. Mex. Hist. Nat. 10(1–4): 329–336. [Biographical accounts are given of C. C. W. Sartorius (1796–1872) and C. A. Purpus (1851–1941), the former the owner of the well-known Hacienda El Mirador in Veracruz and host to numerous natural history collectors, the latter an important botanical collector in Mexico. A portrait of Sartorius and a group photograph, including both Sartorius and Purpus, are presented.]

LANGMAN, IDA K[APLAN]. 1953. *Botanical impressions of travels in Mexico*. Asa Gray Bull., n.s., 2: 291–296. [Includes itineraries of Langman's collecting trips and collection numbers.]

LANGMAN, IDA K[APLAN]. 1955. *Ensayo para una bibliografía historico-biográfica de la botánica en Mexico*. Mem. Acad. Nac. Cienc. Mex. 57: 373–429. [This paper contains annotated biographical references for 81 botanists and other persons who collected plants in Mexico. Also includes an index of authors and references to the botanical history of Mexico.]

LANGMAN, IDA KAPLAN. 1964. *A Selected Guide to the Literature on the Flowering Plants of Mexico*. Philadelphia: Univ. Pennsylvania Press, 1015 pp. [This is an indispensable bibliography for Mexican plants and botanists. The coverage is extensive to 1950, and some entries published as late as 1962 are included. Most of the references are about the taxonomy, biogeography, distribution, and economic uses of Mexican plants, but many involve travels of naturalists and their search for plants. Others are historical in nature. Langman presents a brief historical review (p. 11) of bibliographic works on Mexican plants. There is also an extensive list of bibliographic references consulted. Her list of journal titles is also an invaluable aid to tracking down the titles of many obscure publications. There is a very comprehensive index (156 pp.) for this work.]

LANGMAN, IDA K[APLAN]. 1969. *Recuerdos del Profesor Maximino Martínez*. Bol. Soc. Bot. Méx. 30: 27–29. [Biographical.]

LANJOUW, J[OSEPH]. 1945. *On the location of botanical collections from Central and South America*, pp. 224–235, in *Plants and Plant Science in Latin America*, (F. Verdoorn, ed.), Waltham, Mass.: Chronica Botanica, 381 pp. [After a brief introduction, a listing is presented, by country or region, of plant collectors and an indication of the herbaria in which their specimens are preserved. Mexico is treated on pp. 228–229, with entries for 98 collectors.]

LENZ, LEE W. 1986. *Marcus E. Jones, Western Geologist, Mining Engineer, & Botanist*. Claremont: Rancho Santa Ana Botanic Garden, 486 pp. [Definitive biography of Jones, including his travels in northwestern Mexico and Baja California; includes his diary and field notes for 1894 (App. 1, pp. 253–290), a detailed gazetteer (App. 2, pp. 291–402) in which Mexican localities are found, and a complete list of new taxa described by Jones (App. 3, pp. 403–465), some of which are from Mexico.]

LEÓN, NICOLÁS. 1895. *Biblioteca Botánica-Mexicana. Catálogo bibliográfico y crítico de autores y escritos referentes a vegetales de México y sus aplicaciones desde la conquista hasta el presente*. Mexico: Oficina Tip. Secr. Fomento, 372 pp. [This is an extensive early bibliography of the botany of Mexico. It includes 805 entries and 82 appendices. Many of the references are annotated and in some cases biographical material is included. There are brief biographical accounts and discussion of contributions of many early botanists who worked in Mexico. A special section entitled "Exploraciones botánicas en México" is included on pp. 297–372. This is a useful early bibliography of botany in Mexico; however, Langman (1964) offers a number of criticisms of it. According to her, this bibliography was assembled in the short period of 2 1/2 months and some important references were left out, some insignificant ones were included, and there is no subject index.]

LEÓN, NICOLÁS. 1909. *Los manuscritos botánicos de Berlandier*. Cron. Méd. Méx. 12: 276–278. [Lists manuscripts of Berlandier in the Smithsonian Institution.]

LEONARD, CARMEN COOK DE. 1955. *Blas Pablo Reko*. Méx. Antiguo 8: 10–14. [Biography of Blas Pablo Reko, Mexican ethnobotanist and physician, with list of publications.]

LEÓN DE LA CRUZ, JOSÉ LUIS. 1992. *Annetta Mary Carter (1907–1991)*. Acta Bot. Mex. 17: 1–2. [Obituary and tribute; Carter collected plants extensively in Baja California.]

LEOPOLD, A[LDO] STARKER. 1959. *Wildlife of Mexico. The Game Birds and Mammals*. Berkeley: Univ. California Press, 568 pp. [This is a major contribution to the knowledge of the biology, abundance, distribution, and need for conservation of game animals in Mexico. A map is provided showing the routes and camps of the author as he travelled over a large area of Mexico while observing animals and collecting specimens.]

LEUENBERGER, BEAT ERNST. 1988. *In memoriam. Hernando Sánchez-Mejorada*. Kakteen Sukk. 39(10): 229. [A brief biographical account and tribute to a noted Mexican cactologist.]

LEVIN, GEOFFREY A., AND REID [VENABLE] MORAN. 1989. *The vascular flora of Isla Socorro, Mexico*. Mem. San Diego Soc. Nat. Hist. 16, 71 pp. [A summary of plant collectors and their collections on Isla Socorro during the period 1887–1988 is presented on pp. 7–10. A table is provided, which includes collectors, dates, localities, number of specimens collected, and repositories of specimens. Emphasis is placed on the collecting activities of Alfred L. Stockton on the *Wahlberg* and Frederick E. Barkelew.]

LEVITON, ALAN E[DWARD], AND BENJAMIN H[ARRISON] BANTA. 1964. *Midwinter reconnaissance of the herpetofauna of the Cape Region of Baja California.* Proc. Calif. Acad. Sci. 30(7): 127–156. [Includes a list of herpetological collecting stations in the Cape Region during the period December, 1958–January, 1959. The expedition also included Hugh B. Leech as entomologist, the botanists Ira L. Wiggins, Duncan Porter, and Reid Moran, and a malacologist, Allyn G. Smith.]

LINCECUM, JERRY BRYAN, AND EDWARD HAKE PHILIPS (eds.). 1994. *Adventures of a Frontier Naturalist. The Life and Times of Dr. Gideon Lincecum.* College Station: Texas A&M Univ. Press, 321 pp. [This is an autobiography of Gideon Lincecum edited from four of his memoirs. Lincecum was an early naturalist in Texas, who after the Civil War moved to the Tuxpan area on the Gulf of Mexico. He lived there for about six years (1867–1873), and during this period collected and sent plants and animals to the Smithsonian Institution. See: Burkhalter (1965) for additional information on the many interests and accomplishments of Lincecum.]

LICHTENSTEIN, MARTIN HEINRICH KARL. 1838 [1839]. *Beitrag zur ornithologischen Fauna von Californien.* Abh. Akad. Wiss. Berlin. 1838: 417–451. [An account is given of the travels of Ferdinand Deppe in Baja California, based on letters received from the traveler. The overland part of the trip was from San Loreto northward to San Diego. He recounts the difficulties of travel, the scarcity of people, and something of the vegetation and natural history observed. The principal interest of the trip was ornithological, and the account concludes with detailed discussions (and illustrations) of particular species of birds studied.]

LIEBMANN, FREDERIK MICHAEL. 1843. *Nachrichten über die Reise des dänischen Botanikers Liebmann in Mejico.* Flora 26(1): 108–118. [Liebmann's letters describing his travels in Mexico. After arriving in Veracruz (7 February 1841) and outfitting for the field (giving prices of mules, drying paper, feed for mules, wages for mule drivers, etc.), Liebmann recounts his itinerary. He comments freely on the effects of altitude on the vegetation, on vanilla harvesting, and mentions plants observed. The account is incomplete, because only some of the letters that he wrote are included. The letters were translated by C. F. Hornschuch. See: Langman (1964) for further bibliographical notes.]

LINDEMANN, EDWARD VON. 1884–1885. *Verzeichniß derjenigen Botaniker welche zu meinem Herbarium beigetragen haben.* Bull. Soc. Imp. Naturalistes Moscou 60: 272–312; 61: 37–90. [Includes biographical information on Ferdinand Deppe, Wilhelm Schaffner, and Christian Julius Wilhelm Schiede, all of whom collected in Mexico. The information cited above was taken from Langman (1964). We did not see this publication.]

LINDEN, JEAN [JULES]. 1867. *Les explorations botaniques de la Colombie et en particulier le voyage de M. J. Linden de 1840 a 1844.* Belgique Hort. 17: 235–256. [Although this paper is mostly about Linden's travels in northern South America, there is a brief account of his travels and collecting in Mexico during the period 1838–1840 with Nicolas Funck and Auguste Boniface Ghiesbreght (pp. 245–246). During this period the three naturalists traveled widely in southern Mexico and the Yucatan Peninsula.]

LINDSAY, GEORGE [EDMUND]. 1939. *Eight days in Sonora.* Cact. Succ. J. 10: 148–151. [Description of a short trip to southern Sonora to observe and collect cacti.]

LINDSAY, GEORGE [EDMUND]. 1940. *Vacation in Mexico*. Cact. Succ. J. 12(1): 6–12. [Cactus-collecting trip through northern Mexico.]

LINDSAY, GEORGE [EDMUND]. 1943. *Plant hunting in the Tarahumare Mountains of Chihuahua*. Cact. Succ. J. 15: 47–52, 71–74. [A travel account in Lindsay's easily readable style, including descriptions of the country and frequent mention of plants, especially cacti; photographs.]

LINDSAY, GEORGE [EDMUND]. 1945. *The genus Cochemiea*. Abbey Garden Press, Pasadena, California, 15 pp. [Contains a considerable amount of information on early collectors of this cactus genus in Baja California, including W. M. Gable, C. A. Purpus, Charles F. Pond, T. S. Brandegee, and the author.]

LINDSAY, GEORGE [EDMUND]. 1947–1948. *A cruise in the Gulf of California*. Cact. Succ. J. (1947) 19: 182–186; (1948) 20: 7–9,17–20, 31–35. [Cruise aboard the *Adventurous* in the Gulf of California. Narrative of an extended trip (of a month), especially in the northern part of the Gulf, visiting islands along the east coast of Baja California, touching the west coast of the mainland at Guaymas and Mazatlán; photographs of cacti and other succulents; collected cacti.]

LINDSAY, GEORGE [EDMUND]. 1952. *The Sefton Foundation–Stanford University expedition to the Gulf of California 1952*. Belvedere Scientific Fund, 98 pp. [This is a typed account of a 61-day expedition to the Gulf of California on the research ship *Orca*, sponsored by the J. W. Sefton Foundation. In addition to George Lindsay, the scientific investigators on the expedition were Reid V. Moran, William C. Steere, Jay M. Savage, Frank S. Cliff, James E. Böhlke, Daniel M. Cohen, Jon M. Lindbergh, and John P. Figg-Hoblyn. These specialists covered botany, herpetology, ichthyology, and entomology. An interesting day-by-day description of the trip and collecting activities constitutes most of the publication. In addition, the preliminary results of the expedition are discussed, and the route followed is mapped.]

LINDSAY, GEORGE [EDMUND]. 1955. *Notes concerning the botanical explorers and exploration of Lower California, Mexico*. Stanford: Stanford Univ. Press; reprinted by the Belvedere Scientific Fund, 105 pp. + unpaginated index and map. [This work begins with a brief history of Baja California and natural history explorations. The second, and major, portion consists of discussion of a large number of persons who collected plants there with dates and localities of their collections. The major organized expeditions that have visited Baja California are also discussed. Ethyl Bailey Higgins contributed the section entitled "A botanical bibliography for Lower California," which includes an extensive list of references on the subject. Numerous portraits are included. This is an excellent introduction to the history of botanical exploration of Baja California by an author who has also contributed a great deal to the subject in other papers.]

LINDSAY, GEORGE [EDMUND]. 1962a. *A short trip to Sonora*. Cact. Succ. J. 34(4): 115–122. [Account of a week-long trip in Sonora, Mexico, with members of the San Diego Natural History Museum, John and Priscilla Sloan and Chris Parrish. Plants and animals were both collected, with major emphasis on cacti. Includes map and photographs.]

LINDSAY, GEORGE [EDMUND]. 1962b. *The Belvedere expedition to the Gulf of California*. Trans. San Diego Soc. Nat. Hist. 13: 1–44. [Twelve biologists participated in this expedition to the Gulf of California in 1962, visiting the

major islands in the Gulf and also occasionally the Baja California peninsula. Travel was on the ship *San Agustín II* sponsored by the San Diego Natural History Museum through financial support of the Belvedere Scientific Fund. There is a detailed log of the journey and a map showing the route followed. Well illustrated with photographs. A wide variety of plants and animals was collected.]

LINDSAY, GEORGE [EDMUND]. 1963. *A flying trip for cacti*. Cact. Succ. J. 35(3): 71–73. [Travel by airplane to Isla de Cedros, off the west coast of Baja California, to collect cacti; photographs.]

LINDSAY, GEORGE [EDMUND]. 1964. *Sea of Cortez expedition of the California Academy of Sciences June 20–July 4, 1964*. Proc. Calif. Acad. Sci., ser. 4, 30: 211–242. [Narrative of a collecting trip to islands in the southern part of the Gulf of California. The party consisted of 13 biologists, who collected a large variety of organisms. The expedition was well documented with photographs.]

LINDSAY, GEORGE [EDMUND]. 1966a. *The Gulf islands expedition of 1966*. Proc. Calif. Acad. Sci., ser. 4, 30 (16): 309–355. [This was a cooperative effort of the California Academy of Sciences and the Instituto de Biología de México. Thirteen scientists participated in a cruise April 19–29, 1966, to investigate 13 islands in the central Gulf of California. A detailed log of the trip and maps and photographs are included. Many kinds of organisms were collected.]

LINDSAY, GEORGE [EDMUND]. 1966b. *Guadalupe Island*. Pacific Disc. 19(3): 2–11. [Narrative of a trip by Lindsay and botanist Reid Moran to Guadalupe to observe the isolated fauna and flora of the island. Discusses the ecology and need for conservation of the native plants and animals. Profusely illustrated with photographs.]

LINDSAY, GEORGE [EDMUND]. 1983. *History of scientific exploration in the Sea of Cortez,* chapter 1, pp. 3–12, in *Island Biogeography in the Sea of Cortez* (Ted J. Case and Martin L. Cody, eds.), Berkeley: Univ. California Press, 508 pp. [General review of natural history exploration of area, with mention of many expeditions and individuals involved in studies of the flora and fauna of Baja California. This is an excellent modern account, which would be a solid starting point for anyone interested in the history of Baja California exploration.]

LINDSAY, GEORGE [EDMUND]. 1988. *Hernando Sánchez-Mejorada R*. Cact. Succ. J. 60: 203–204. [Obituary of Sánchez-Mejorada, emphasizing his contributions to the knowledge of Cactaceae in Mexico; photographs.]

LONG, ESMOND R. 1959. *Daniel Trembly MacDougal (1865–1958)*. Amer. Phil. Soc. Year Book 1958: 131–135. [Biographical; MacDougal traveled extensively in the deserts of northern Mexico to study plant physiology and ecology.]

LORENCE, DAVID H., AND ABISAÍ GARCÍA MENDOZA. 1989. *Oaxaca, Mexico*, pp. 253–269, in *Floristic Inventory of Tropical Countries* (D. G. Campbell and H. D. Hammond, eds.), New York Bot. Gard., 545 pp. [Brief history of plant collecting in the area discussed in the section "Important Collectors."]

LOWERY, GEORGE H[INES], JR., AND WALTER W. DALQUEST. 1951. *Birds from the State of Veracruz, Mexico*. Univ. Kansas Publ. Mus. Nat. Hist. 3(4): 531–649. [Discusses the author's collecting in Veracruz. Provides a gazetteer of localities where birds included in the paper were collected.]

LOZOYA, XAVIER. 1984. *Plantas y Luces en México. La Real Expedición Científica a Nueva España (1787–1803).* Barcelona: Ediciones del Serbal, 224 pp. [Detailed account of the Sessé & Mociño expeditions, profusely illustrated, including handwriting samples, botanical and zoological illustrations, scenes, portraits of various and sundry persons (but not of Sessé or Mociño).]

LUMHOLTZ, CARL. 1902. *Unknown Mexico. A Record of Five Years' Exploration Among the Tribes of the Western Sierra Madre; In the Tierra Caliente of Tepic and Jalisco; and Among the Tarascos of Michoacán.* New York: Charles Scribner's Sons. 2 vols., pp. 530 + 496. [This is a general account of the travels of Lumholtz, an anthropologist, in Nayarit, Jalisco, and Michoacán, including material of interest to natural history. Both plants and animals were collected. The Rio Grande Press published a beautiful reprint of this work in 1973 with additional introductory material and many new color plates. The introduction by Thomas B. Hinton in the Rio Grande Press edition briefly reviews this publication and other works by Lumholtz. A map of Lumholtz's travel routes is included in volume 2.]

LUMHOLTZ, CARL. 1912. *New Trails in Mexico. An Account of One Year's Exploration in North-Western Sonora, Mexico and South-Western Arizona, 1909–1910.* New York: Charles Scribner's Sons, 411 pp. [Travels in Sonora and Sinaloa are described. Robert B. McCoy, in a 1971 reprint of this book by The Rio Grande Press, says that it is good adventure as well as a solid source of information on the geography, geology, natural history, and ethnography of the area covered. The reprint edition presents a biography of Lumholtz and a list of of his publications, which were not included in the original edition.]

LUMHOLTZ, CARL. 1921. *My life of exploration.* Nat. Hist. 21(3): 225–243. [Summary of Lumholtz's travels, including those to western Mexico during the period 1890–1910. Lumholtz was primarily interested in the ethnology of Mexican Indians but sometimes had associates on his trips who collected plants and animals.]

LUNDELL, C[YRUS] [LONGWORTH]. 1938. *The 1938 botanical expedition to Yucatán and Quintana Roo.* Carnegie Inst. Wash. Year Book 37: 143–147. [This is an account of plant collecting during the period May 27–August 3, 1938, in the states of Yucatán and Quintana Roo. Reptiles, amphibians, and fishes were collected incidental to plant collecting. The area and its vegetation are described.]

MABBERLEY, D. J. 1985. *'Die neuen Pflanzen von Ch. Huber Frères & Co. in Hyères.'* Taxon 34(3): 448–456. [Briefly discusses the botanical travels of Benedict Roezl in Mexico. See also: Gardener's Chronicle II, (1874): 73; and Botanical Gazette 48 (1909): 462–463, for Roezl's itineraries.]

MACDOUGAL, D[ANIEL] T[REMBLY]. 1904. *Botanical exploration in the southwest.* J. New York Bot. Gard. 5(53): 89–98. [Narrative of travel in Texas, Arizona, Sonora, and Baja California to study and collect plants during January–February, 1904; photographs.]

MACDOUGAL, D[ANIEL] T[REMBLY]. 1905. *Botanical explorations in Arizona, Sonora, California, and Baja California.* J. New York Bot. Gard. 6(66): 91–102. [MacDougal writes about a trip to the Colorado River delta area in the United States and Mexico during March–April, 1905, to study the flora; photographs.]

MacDougall, Thomas B[aillie]. 1948. *Afoot in Mexico. A visit to the Flower Mountain of Lachiquiri.* J. New York Bot. Gard. 49(583): 153–163. [A travel account about collecting plants on the mountain Lachiquiri in Oaxaca, near Tehuantepec; photographs.]

MacDougall, Thomas B[aillie]. 1953. *In the wetlands of northern Chiapas.* Cact. Succ. J. 25(6): 159–163. [Plant-collecting trip in 1950; describes country and vegetation in area north of Tuxtla Gutiérrez (on road to Pichucalco).]

MacDougall, Thomas B[aillie]. 1955. *In the footsteps of Purpus.* Cact. Succ. J. 27(1): 23–27. [Descriptions of trips in 1950 and 1951 to the Monserrata area on the Chiapas–Oaxaca border to collect and study plants in a locality previously collected by C. A. Purpus; photographs.]

MacDougall, Thomas B[aillie]. 1971. *The Chima wilderness.* Explorers J. 49(2): 86–103. [MacDougall describes his travels in the Chima area in the far eastern part of the state of Oaxaca during the period 1940–1967 (several trips). Aside from his travel narrative, plants and animals encountered are mentioned; includes many photographs and a map of the area. This is an interesting account of travel and collecting in a biologically rich region by a seasoned collector and explorer.]

MacDougall, Thomas B[aillie]. 1972. *Plant exploration in the states of Oaxaca and Chiapas. The cactus and succulent field notes of Tom MacDougall 1936–1971.* Cact. Succ. J., 58 pp. [Photocopied transcription of field notes of MacDougall concerning his travels in Oaxaca and Chiapas, and observations on and collections of cacti and succulents. Many plants are mentioned by scientific names. Also includes copies of correspondence dealing with the preparation of these notes.]

Madden, Henry Miller. 1949. *Xántus, Hungarian Naturalist in the Pioneer West.* Palo Alto, California: Books of the West, 312 pp. [This is a scholarly biography of John Xántus with an account of his travels and natural history collecting in the United States and Mexico. His Mexican travels and collecting are described in Chapter IV "Cape San Lucas, 1859–1861," and Chapter VI "Manzanillo and Colima 1863–1864." Xántus made extensive collections for the Smithsonian Institution through the assistance and encouragment of S. F. Baird. Another edition of this book, identical to the Palo Alto edition, except for reference to its fulfilling degree requirements and a short vita, was published under the same title and date in Linz, Austria.]

Madulid, D. A. 1989. *The life and work of Luis Née, botanist of the Malaspina expedition.* Arch. Nat. Hist. 16: 33–48. [Description of Née's botanical travels in Mexico, where he collected nearly 3,000 plant specimens as part of the Malaspina Expedition. See also: Higueras (1989); Engstrand (1981).]

Mailliard, Joseph. 1923. *Expedition of the California Academy of Sciences to the Gulf of California in 1921. The birds.* Proc. Calif. Acad. Sci., ser. 4, 12(24): 443–456. [Some information is presented on itinerary. See Slevin (1923) for general account of the expedition, itinerary, and a map showing routes.]

Mallis, Arnold. 1971. *American Entomologists.* New Brunswick: Rutgers Univ. Press, 549 pp. [Biographies and portraits of about 200 North American entomologists, including several (Thomas Say, P. P. Calvert, W. S. Blatchley, W. M. Mann, C. H. T. Townsend, and Alfonso Dampf) who travelled and collected insects in Mexico.]

MALDONADO-KOERDELL, M[ANUEL]. 1951. *Algunos aspectos de la obra científica del Prof. Cassiano Conzatti.* Rev. Soc. Mex. Hist. Nat. 12: 291–301. [An evaluation of the contributions of Conzatti to Mexican botany, especially to the knowledge of plants of Oaxaca.]

MANN, WILLIAM M. 1948. *Ant Hill Odyssey.* Boston: Little, Brown and Co., 338 pp. [Mann, a specialist in ants and later Director of the National Zoo, writes about his travels to southern Mexico to collect insects.]

MARES, MICHAEL A., AND DAVID J. SCHMIDLY (eds.). 1991. *Latin American Mammalogy: History, Biodiversity, and Conservation.* Norman: Univ. Oklahoma Press, 468 pp. [Includes many contributions on the mammalogy of Latin America, including some history of the collection and study of mammals of Mexico.]

MARTIN, PAUL S., C. RICHARD ROBINS, AND WILLIAM B. HEED. 1954. *Birds and biogeography of the Sierra de Tamaulipas, an isolated pine-oak habitat.* Wilson Bull. 66(1): 38–57. [Itinerary, map, and detailed description of the geology and vegetation of the seldom visited Sierra, the last used as a background for interpreting faunal distributions. Also contains a list of vertebrates collected.]

MARTÍNEZ, MAXIMINO. 1954. *Nota necrológica.* Bol. Soc. Bot. Méx. 16: 25–27. [Biographical sketch of Blas Pablo Reko, plant collector in southern Mexico; portrait.]

MCCLENDON, J[ESSE] F[RANCIS]. 1906. *Notes on collecting in Mexico.* Entomol. News 17(1): 26–27. [Collected insects around Guadalajara, June–September, 1903.]

MCGOVERN, WILLIAM L., GERALD H. MCKIBBEN, JAMES W. SMITH, PATRICIA R. MILLER, WILLIAM L. JOHNSON, AND FRANK J. BENCI. 1984. *William Henley Cross 1928–1984.* Bull. Entomol Soc. Amer. 30(4): 67. [Obituary. Cross collected insects extensively over a broad area of Mexico in conjunction with his study of the boll weevil. Most of the material collected is deposited in the Mississippi Entomological Museum at Mississippi State University.]

MCKELVEY, SUSAN DELANO. 1955. *Botanical Exploration of the Trans-Mississippi West 1790–1850.* Jamaica Plain, Massachusetts: Arnold Arboretum, Harvard Univ., 1144 pp. + maps. [Although this work deals primarily with plant exploration north of the Mexico–United States boundary, it includes a number of collectors important to Mexican botany. This is an important source of information about botanists and their travels in western North America until 1850. It was reprinted in 1991 by the Oregon State University Press with a new introduction, foreword, and maps.]

MCVAUGH, ROGERS. 1943. *The travels of Thomas Coulter, 1824–1827.* J. Wash. Acad. Sci. 33: 65–70. [An account of Coulter's travels and plant collections in Mexico, including generous excerpts from his previously unpublished notebook and a map of his Mexican travels.]

MCVAUGH, ROGERS. 1951. *The travels and botanical collections of Eugène Langlassé in Mexico and Colombia, 1898–1899.* Candollea 13: 167–211. [In addition to biographical materials, this paper includes a detailed gazetteer of Langlassé's travels and collecting localities in Mexico; map.]

MCVAUGH, ROGERS. 1952a. *A trip to a botanically little known area in Querétaro.* Asa Gray Bull., n.s., 1: 169–174. [A colorful account of a trip by McVaugh and R. L. Wilbur from Querétaro to Pinal de Amoles in NE Querétaro to collect plants in 1949.]

MCVAUGH, ROGERS. 1952b. *Mexican botanical expedition of 1952.* Asa Gray Bull., n.s., 1: 295–297, 369–381. [A compilation of letters written by McVaugh to

H. H. Bartlett during the former's travels (with Joseph Sooby) in and around the Nevado de Colima and in parts of Jalisco. To this is appended a summary list giving dates, localities, and plant collection numbers.]

McVaugh, Rogers. 1952c. *"The Barranca of Guadalajara" and its place in botanical literature.* Asa Gray Bull., n.s., 1: 385–390. [A discussion of the system of barrancas in the immediate vicinity of Guadalajara and its importance as a locality of early collectors, especially H. G. Galeotti, E. Palmer, and C. G. Pringle; map.]

McVaugh, Rogers. 1956. *Edward Palmer. Plant Explorer of the American West.* Norman: Univ. Oklahoma Press, 430 pp. [McVaugh presents a comprehensive work on the life, travels, and accomplishments of one of North America's foremost plant collectors. Palmer collected extensively in both the western United States and Mexico. In addition to plants, he collected animals and ethnological materials. Also included is an extensive geographical index to Palmer's travels, including localities where he collected, dates, collection numbers, and other information.]

McVaugh, Rogers. 1969. *El itinerario y las colectas de Sessé y Mociño en México.* Bol. Soc. Bot. Méx. 30: 137–142. [Brief discussion of the botanical explorations of Sessé and Mociño with a map of their travels in central Mexico.]

McVaugh, Rogers. 1970. *Introduction to Bentham's Plantae Hartwegianae*, pp. 1–102, in *Plantae Hartwegianae*, by G. Bentham. Reprint, Lehre: J. Cramer. [Provides an extensive account of travel and collecting localities of Karl Theodor Hartweg in California, Mexico, Central America, and South America. Also contains maps of Hartweg's principal collecting areas in Mexico.]

McVaugh, Rogers. 1972. *Botanical exploration in Nueva Galicia, Mexico, from 1790 to the present time*. Contr. Univ. Michigan Herb. 9: 205–357. [McVaugh presents a history of botanical collecting in Nueva Galicia (including Jalisco, Colima, Aguascalientes, and parts of adjacent states). Included is a listing of individual collectors who are known to have worked in the region, with as much detail as is available about their activities and itineraries. In some cases this information is obtained from published sources, in other cases from the study of collection labels or field notebooks. Added to this is a detailed gazetteer of localities and a map of the region. This is a major resource on plant collecting in western Mexico, not only dealing with collectors of major importance, but also including minor or incidental collectors about whom relatively little is known.]

McVaugh, Rogers. 1977. *The botanical results of the Sessé & Mociño expedition (1787–1803). I. Summary of excursions and travels*. Contr. Univ. Michigan Herb. 11: 97–195. [Presented herein is a careful treatment of the travels of the members of the Royal Botanical Expedition to New Spain (Sessé and Mociño Expedition) of 1787–1803. A narrative account (almost day by day) of the several excursions is supplemented by a detailed gazetteer of localities visited. The personnel involved (Sessé, Cervantes, Mociño, Longinos Martínez, Castillo, Sanseve, Maldonado, Echeverría, Cerda, and Villar) are discussed individually.]

McVaugh, Rogers. 1978. *Galeotti's botanical work in Mexico: the numbering of his collections and a brief itinerary*. Contr. Univ. Michigan Herb. 11: 291–297. [H. G. Galeotti traveled and collected plants in Mexico, 1835–1840. McVaugh presents a tentative itinerary and locality list from the imperfect and incomplete information available.]

McVaugh, Rogers. 1980. *Karwinski's itineraries in Mexico, 1827–1832 and 1841–1843.* Contr. Univ. Michigan Herb. 14: 141–152. [McVaugh traces W. F. Karwinski's plant-collecting trips in Mexico in considerable detail. Maps of his routes and collecting localities are provided.]

McVaugh, Rogers. 1987. *Itinerary and gazetteer*, pp. 5–38, in *Liebmann's Mexican ferns* by J. T. Mickel. Contr. New York Bot. Gard. 19: 1–173. [Concerns collections of Frederik Michael Liebmann in Veracruz, Puebla, and Oaxaca. A gazetteer is included.]

McVaugh, Rogers. 1990. *Botanical results of the Sessé and Mociño expedition (1787–1803): IV. The library and the herbarium of the expedition.* Contr. Univ. Michigan Herb. 17: 183–214. [A careful accounting of the contents of the library available to the expedition and its use by members of the expedition in studying the Mexican flora. The herbarium, preserved in Madrid, is analyzed as to its history and present scientific value. The herbarium labels are analyzed in detail and compared with handwriting samples of Sessé, Mociño, and Juan del Castillo. The numbering system used on the labels is clarified as well as various abbreviations used.]

McVaugh, Rogers. 1991. *Exploración botánica en Nueva Galicia y su importancia en la producción de una nueva Flora Novo-Galiciana.* Bol. Inst. Bot. Univ. Guadalajara, ser. 3, 1(1): 1–7. [A generalized and abbreviated account of material contained in McVaugh (1972).]

Mearns, Barbara, and Richard Mearns. 1992. *Audubon to Xantus. The Lives of Those Commemorated in North American Bird Names.* London: Academic Press, 588 pp. [Includes biographical sketches of several persons who collected in Mexico, including Aglaé Brelay, Matteo Botteri, John Henry Clark, Darius Nash Couch, Federico Craveri (map of Craveri's travels in Baja California and mainland western Mexico), and Thomas Say; portraits.]

Mearns, Edgar Alexander. 1907. *Mammals of the Mexican Boundary of the United States. A Descriptive Catalogue of the Species of Mammals Occurring in That Region; With a General Summary of the Natural History, and a List of Trees.* U.S. Natl. Mus. Bull. 56, pt. 1. *Families Didelphiidae to Muridae*, 530 pp. [Discusses the organization of the International Boundary Commission and establishment of the Biological Section of the Survey. Includes the itinerary for travel during 1892–1894. Although most of this work is descriptive, a considerable portion is devoted to travel accounts. Some collecting was done in Chihuahua and Sonora. See also: Richmond, Charles W., 1917. *In Memoriam—Edgar Alexander Mearns, 1856–1916.* Ann. Rept. Smithsonian Institution, pp. 649–662, for biography and portrait of Mearns.]

Meine, Curt. 1988. *Aldo Leopold. His Life and Work.* Madison: Univ. Wisconsin Press, 638 pp. [Discusses Leopold's travels in Mexico in 1922, 1936, 1937, and 1938. Leopold visited Mexico mainly to hunt, but his ecological and conservationist views permeate his writings about the country.]

Meredith, DeWitt. 1939. *Voyages of the Velero III. A Pictorial Version with Historical Background of Scientific Expeditions Through Tropical Seas to Equatorial Lands Aboard M/V Velero III.* Los Angeles: Bookhaven Press, 286 pp. [An account of the Allan Hancock Expeditions in the eastern Pacific, including considerable information on cruises to study the natural history of Baja California and the Gulf of California. Maps of the major *Velero III* cruises are presented on pp. 120–121. All of these cruises touched

the coast of western Mexico and some entered the Gulf of California. This book is profusely illustrated with photographs.]

MEXIA, YNÉS. 1929. *Botanical trails in Old Mexico—The lure of the unknown.* Madroño 1: 227–238. [Describes a trip to western Mexico, September 2, 1926, to April 19, 1927. An interesting travelogue by an important plant collector; detailed itinerary.]

MEYER, R. 1919. *Heinrich Poselger.* Monatsschr. Kakteenk. 29(9): 97–100. [Including travels of Poselger in Mexico from 1849–1851 to collect cacti.]

MICHELBACHER, A[BE] E[ZRA], AND E[DWARD] S[HEARMAN] ROSS. 1942. *Contributions toward a knowledge of the insect fauna of Lower California. 1. Introductory account.* Proc. Calif. Acad. Sci., ser. 4, 24: 1–20. [A brief but useful historical review of insect collecting in Baja California; detailed itinerary of the author's collecting trip to the region in 1938.]

MICKEL, JOHN T. 1965. *Preliminary field studies on the fern flora of Oaxaca, Mexico.* Amer. Fern J. 55: 74–79, 117–122. [Narrative of travel in 1962 to collect ferns in Oaxaca; route mapped.]

MIESCHER, FRIEDRICH. 1878. *Dr. Gustav Bernoulli.* Verh. Naturf. Ges. Basel 6: 710–737. [Biography of botanist, including visit to Chiapas in 1877, pp. 722–725.]

MILLER, LOYE [HOLMES]. 1950. *Lifelong Boyhood. Recollections of a Naturalist Afield.* Berkeley: Univ. California Press, 226 pp. [In the chapter entitled "The Cape Region of Baja California" (pp. 73–101), Miller describes a trip made during May–September, 1896, to collect birds. Mentions the general natural history of the area covered.]

MILLER, MAX. 1951. *The Cruise of the Cow. Being an Introduction to San Diego, Mexico's Baja California, and a Voyage into the Gulf of California—This Combined Region of the Southwest Corner.* New York: E. P. Dutton & Co., Inc., 256 pp. [Narrative of a trip to Baja California, most of which was accomplished in an open boat, the *Scared Cow*, along the upper one-third of the Gulf of California. Several islands were visited in the Gulf and some natural history observations and collections were made. Many photographs of landscapes, fish, and birds are included.]

MILLER, ROBERT C. 1965. *The other California.* Pacific Disc. 18(4): 1. [A short history of natural history explorations by the California Academy of Sciences in Baja California.]

MILLER, ROBERT RYAL. 1968. *For Science and National Glory. The Spanish Scientific Expedition to America, 1862–1866.* Norman: Univ. Oklahoma Press, 194 pp. [The Spanish "Scientific Commission of the Pacific" travelled and collected extensively in South America during the period 1862–1866. Although the expedition visited both the east and west coasts of the United States, the itinerary did not include Mexico, except for a brief fueling stop of one ship at Acapulco. This reference is included because Francisco Hernández's collection and study of Mexican plants and animals is briefly discussed, and a history of Spanish scientific exploration in the New World is presented as part of the introductory material. A later, more extensively illustrated, edition has been published: MILLER, ROBERT RYAL. 1983. *Por la Ciencia y la Gloria Nacional. La Expedición Científica Española a América (1862–1866).* Barcelona: Ediciones del Serbal, 256 pp.]

MILLS, LESLIE ANNE. 1958. *Rugged road to cacti.* Cact. Succ. J. 30(3): 67–70. [Trip to Baja California from Tijuana to La Paz, with descriptions of habitats and cacti collection sites.]

MILLS, LESLIE ANNE. 1959. *Back to Baja California.* Cact. Succ. J. 31(4): 103–106. [Description of a trip to as far south as Bahía de los Angeles to collect cacti.]

MILLS, LESLIE ANNE. 1960. *Third trip to Mexico.* Cact. Succ. J. 32(5): 153–156. [The third in a series of trips to Baja California to collect cacti.]

MIRANDA, FAUSTINO. 1950. *Por tierras de Chiapas.* Chiapas 1(9): 24–30, 33. [Ex Langman (1964), "Description of a trip from Tuxtla to Simojovel and from there to Tres Picos, with references to the vegetation seen on the way."]

MIRANDA, FAUSTINO. 1961a. *La botánica en México en el último cuarto de siglo.* Rev. Mex. Hist. Nat. 22: 85–111. [A historical account of the botanists and their publications in Mexico. Detailed citations of publications of authors given. No information is presented on travel.]

MIRANDA, FAUSTINO. 1961b. *Tres estudios botánicos en la Selva Lacandona, Chiapas, Mexico.* Bol. Soc. Bot. Méx. 26: 133–176. [Introduction by Thomas H. Mills. This paper is mostly descriptive of the area but also includes travel accounts of three botanical trips, the last by Arturo Gómez-Pompa.]

MIRANDA, FAUSTINO. 1969. *El Profesor Maximino Martínez.* Bol. Soc. Bot. Méx. 30: 27. [Biographical.]

MIRANDA, FAUSTINO, AND ROGERS MCVAUGH. 1961. *Novedades de la flora de Jalisco.* Anal. Inst. Biol. Méx. 32: 177–185. [Trip to Colima and western Jalisco.]

MIRANDA, JOSÉ. 1960. *Francisco Hernández. Protomédico e Historiador del Rey de España, Don Felipe II, en las Indies Occidentales, islas y tierra firma del mar oceáno. Obras completas. Tomo I. Vida y obra de Francisco Hernández. Precidida de España y Nueva España en la época de Felipe II.* México, D.F., Univ. Nac. México, 485 pp. [Not seen; cited from Smith and Smith (1973), who consider it "particularly useful in summarizing background information about Hernández."]

MITICH, LARRY W. 1981. *A salute to Joseph Nelson Rose.* Cact. Succ. J. 53(6): 299–302. [About the life and work of Rose who collected extensively in Mexico during the period 1897–1911 (eight trips made to the country during this period). Rose was interested in cacti and collected thousands of specimens. He was on the cruise of the *Albatross* to Baja California and the Gulf of California in 1911; photographs.]

MITICH, LARRY W. 1988, 1989. *George E. Lindsay—explorer and plantsman.* Cact. Succ. J., pt. 1 (1988) 60(6): 278–282; pt. 2 (1989) 61(1): 17–21. [Much about Lindsay's life and work, including collecting in Mexico, especially in Baja California; many photographs.]

MITICH, LARRY W. 1992. *Gilbert Tegelberg, Jr., friend of CSSA.* Cact. Succ. J. 64(6): 291–294. [Biographical with brief mention of cactus-collecting trips to Mexico; photographs.]

MITICH, LARRY W., AND GUY B. KYSER. 1990. *Josiah Gregg, pioneer naturalist.* Cact. Succ. J. 62: 183–189. [An excellent account of Josiah Gregg and his contributions to natural history, including his collections of plants and other organisms in Mexico; portrait. A list of plants named for Gregg is also included; cf. Fulton (1941–44).]

MORAN, REID [VENABLE]. 1952. *The Mexican itineraries of T. S. Brandegee.* Madroño 11: 253–262. [Summary of Brandegee's travels to Mexico with detailed account of collecting localities.]

MORAN, REID [VENABLE]. 1962. *Echeveria lutea and its discoverer, Carl Purpus.* Cact. Succ. J. 34(1): 8–12. [Account of author's finding of the plant near San Luis Potosí in 1957 (with Charles Mieg and George Lindsay); biographical material on Purpus with photograph.]

MORAN, REID [VENABLE]. 1967. *Pachyphytum werdermannii re-collected*. Cact. Succ. J. 39(4): 154–158. [Account of author's trip to the state of San Luis Potosí in 1966 to find this plant.]

MORTON, CONRAD V. 1945. *Mexican phanerogams described by Marcus E. Jones.* Contr. U.S. Natl. Herb. 29: 87–116. [After introductory comments about Jones' collecting activities in Mexico (1926–1930), Morton presents an itinerary, followed by a detailed commentary on all the species of Mexican phanerogams based on types collected by Jones.]

MORTON, CONRAD V., AND RICHARD EVANS SCHULTES. 1942. *Localidades visitadas y rutas recorridas por E. W. Nelson en el estado de Oaxaca*. Anal. Inst. Biol. Méx. 13: 47–51. [Localities and routes of E. W. Nelson during collecting trips of 1894 and 1895; cf. Goldman (1951).]

MULLERRIED, F[EDERICO] K. G. 1948. *La naturaleza en la noreste de Oaxaca.* Rev. Soc. Mex. Nat. Hist. 9: 137–143. [Brief, general description of the region between Oaxaca City and the border with the states of Veracruz and Puebla; map of the area and photographs of representative habitats.]

MULLER, CORNELIUS H., AND ROGERS MCVAUGH. 1972. *The oaks (Quercus) described by Née, and by Humboldt and Bonpland (1809), with comments on related species.* Contr. Univ. Michigan Herb. 9(7): 507–522. [Brief biographical information on Luis Née and his travels to collect plants in Mexico in 1791 as a member of the Malaspina Expedition.]

MURRAY, KEITH F. 1955. *Herpetological collections from Baja California.* Herpetologica 11: 33–48. [Mostly a list of taxa with taxonomic and ecological notes, but in a brief introduction the dates and trips of several collectors are mentioned.]

MURRAY, SPENCER. 1966. *Explorations in Lower California. A Travel Account Penned in 1866 of the Cape Region with Appropriate 1966 Commentary and Guide to Present Resorts and Accommodations.* Studio City, CA: Vaquero Books, 70 pp. [An account of the John Ross Browne expedition to obtain information for colonization purposes; one person on expedition, William M. Gabb, collected some insects and other natural history specimens; originally published in Harpers New Monthly Mag. 37: 578–591, 740–752. 1866.]

MURRILL, W[ILLIAM] A[LPHONSO]. 1910. *Collecting fungi in southern Mexico*. J. New York Bot. Gard. 11(123): 57–77. [Account of a trip covering a large area, collecting principally around Orizaba and Córdoba, during December, 1909, and January, 1910. Descriptive of the country and people; photographs.]

NAVARRO S., ADOLFO G. 1989. *La sistemática ornithológica en Mexico, posibilidades y limitaciones.* Ciencias, Spec. No. 13: 96–102. [Information on the history of collection and study of Mexican birds.]

NELSON, E. CHARLES. 1983. *Thomas Coulter (1793–1843) in North America: Some bibliographic problems and some solutions*, pp. 59–71, in *Contributions to the History of North American Natural History* (A. Wheeler, ed.), Soc. Bibl. Nat. Hist., Sp. Publ. [Includes biographical and bibliographical information for Thomas Coulter and discusses his travels in Mexico and California during the period 1824–1833.]

NELSON, E. CHARLES, AND ALAN PROBERT. 1994. *A Man Who Can Speak of Plants. Dr. Thomas Coulter (1793–1843) of Dundalk in Ireland, Mexico + Alta California.* Dublin, Ireland: privately published, 192 pp. [This book was not seen. The following description is quoted from an advertisement: "This detailed biography, based on Coulter family papers and archival research in Mexico, USA and Europe, is the first complete account of a man

whose name is familiar to plant-lovers in Europe and North America. It includes a full transcript, from the hitherto unpublished original manuscripts, of Thomas Coulter's famous *Notes of Upper California (1835).*"]

NELSON, EDWARD W[ILLIAM]. 1904. *A winter expedition in southwestern Mexico.* Natl. Geogr. Mag. 15: 339–356. [Ex Langman (1964), "Interesting description of a trip west to Chapala, then south through Michoacán and to the coast at Zihuatanejo, then along the coast to Acapulco; references to plants seen are usually by common name only."]

NELSON, EDWARD W[ILLIAM]. 1911. *A land of drouth and desert—Lower California. Two thousand miles on horseback through the most extraordinary cacti forests in the world.* Natl. Geogr. Mag. 22(4): 443–474. [A popular account of the history, natural history, topography, and economic potential of Baja California; photographs; maps. See Nelson (1922) for a fuller and more technical account of his travels in Baja California.]

NELSON, EDWARD W[ILLIAM]. 1922. *Lower California and its Natural Resources.* Natl. Acad. Sci. 16: 1st Memoir, 194 pp. [This book contains a large amount of information about the natural history of Baja California. Nelson presents a day-by-day account of his travels with E. A. Goldman during the U.S. Biological Survey Expedition to Baja California, March, 1905–February, 1906. A brief but excellent discussion of scientific explorations of Baja California through 1911 is presented. There is also an extensive bibliography. Manessier Publications, Riverside, California, reprinted the book in 1966. New biographical information about Nelson and Goldman and their contributions to the field of natural history is added in the reprint. See also: Goldman (1951), and Sterling (1991).]

NISHIDA, FLORENCE H. 1989. *Review of mycological studies in the neotropics,* pp. 494–522, in *Floristic Inventory of Tropical Countries* (D. G. Campbell and H. D. Hammond, eds.), New York Bot. Gard., 545 pp. [Discussion of the collection and study of fungi in tropical America. Several collectors in Mexico are mentioned, including William A. Murrill, who collected extensively in Mexico in the early 1900's.]

NORRIS, JAMES N. 1972. *Marine algae from the 1969 cruise of "Makrele" to the northern part of the Gulf of California.* Bol. Soc. Bot. Méx. 32: 1–30. [Reviews the history of work on marine algae in the Gulf of California and provides an extensive bibliography. The cruise of the *Makrele* took place in April and May, 1969.]

OBER, FREDERICK ALBION. 1884. *Travels in Mexico and Life among the Mexicans.* San Francisco: J. Dewing, 672 pp. [Ober, an ornithologist, travelled widely in Mexico during 1881 and 1883. This book contains some natural history observations, but mostly it is about the people and customs in Mexico. Cole (1978) considers this to be one of the best travel books on Mexico.]

OCHOTERENA, ISAAC. 1923. *El Sr. Ing. D. Carlos Patoni, M.S.A. Breve nota biográfica.* Mem. Soc. Cient. "Antonio Alzate" 42: 389–391. [A brief biography of Carlos Patoni with a listing of his principal contributions and a portrait.]

OPPENHEIMER, EVELYN. 1991. *Gilbert Onderdonk. The Nurseryman of Mission Valley, Pioneer Horticulturist.* Denton: Univ. North Texas Press, 159 pp. [Includes general letters written by Onderdonk about his travels in Mexico during the period 1898–1900 while conducting plant explorations for the U.S. Department of Agriculture.]

ORCUTT, C[HARLES] R[USSELL]. 1883. *Among the palms and the pines.* Bull. Torrey Bot. Club 10: 81–82. [Brief discussion of travel and plants encountered in an eight day trip as far south as the Guadalupe Mountains in northwestern Baja California.]

ORCUTT, C[HARLES] R[USSELL]. 1885. *Stray leaves from a notebook.* West Amer. Sci. 1(8): 56–57. [Day-by-day travel account during June and July, 1885, in northern Baja California, with notes on plants.]

ORCUTT, C[HARLES] R[USSELL]. 1886a. *Northern Lower California.* West Amer. Sci. 2: 37–41. [General account of a trip to northern Baja California; more about the topography, economy, and inhabitants than about natural history.]

ORCUTT, C[HARLES] R[USSELL]. 1886b. *A botanical trip.* West Amer. Sci. 2(17): 53–58. [Orcutt describes a trip in 1886 by wagon to the general area of Ensenada to collect plants and mollusks.]

ORCUTT, C[HARLES] R[USSELL]. 1890. *Charles Christopher Parry.* West Amer. Sci. 7(50): 1–5. [Biographical; travels.]

ORR, ROBERT T. 1965. *An expedition to the Sea of Cortez.* Pacific Disc. 18(3): 9–14. [Account of travel of 11 naturalists (not named except the author, G. E. Lindsay, Bruce Markham, Chris Parrish, and Dustin Chivers) to the islands in the Gulf of California "to collect representative samples of the plant and animal life on some of these islands as well as in the sea around them." Includes a map showing route of expedition; photographs. Reprinted from *Animals* (1965), 6(4): 86–91.]

ORTGIES, E. 1871, 1874. *Bericht über die Reisen und Einführungen des Herrn B. Roezl in den Jahren 1869 und 1870.* Gartenflora (1871) 20: 70–84, 107–117; (1874) 23: 45–53, 69–77. [Langman (1964): "Interesting account with quotes from Roezl's letters."]

PALACIO, RENÉ GROBET. 1982. *El Peregrinar de las Flores Mexicanas, José Mariano Mociño y Losada (1757–1822).* Inst. Nac. Invest. Recur. Biot., Xalapa, 100 pp. [An account of the life and work of J. M. Mociño, including the story of the well-known plates prepared during the explorations of the Mexican flora with full page color reproductions of several of them.]

PALMER, T[HEODORE] S., ET AL. 1954. *Biographies of Members of the American Ornithologists' Union by T. S. Palmer and Others.* Washington, D.C.: Lord Baltimore Press, 630 pp. [A compilation of "about 1,200" biographies (obituaries) of ornithologists that were originally published in *The Auk* (1884–1954). These short biographies were written by different authors, of which T. S. Palmer, J. A. Allen, and Witmer Stone were the most prominent. At least 35 of the persons included here are specifically identified by information in their biographies as having collected and/or observed birds in Mexico. Probably many others included in this book have also traveled and collected in the country. Each biography is referenced to its original publication in *The Auk*.]

PANIAGUA, LIVIA LEÓN. 1989. *Algunos aspectos de la taxonomía Mastozoológica en México: historia, problemática y alternativas.* Ciencias, Spec. No. 13: 8–17. [Contains a brief history of mammalogy in Mexico.]

PAPAVERO, NELSON. 1971, 1973. *Essays On the History of Neotropical Dipterology.* São Paulo, Brazil: Mus. de Zool., Univ. São Paulo. (1971) I, 216 pp. (maps); (1973) II, 217–446 pp. [The contents of this work are much broader than the title implies. Early natural history collectors were seldom specialists, so

many who collected insects also collected other organisms, both plant and animal. There is a considerable amount of information in these two volumes on the work of early naturalists in Mexico and other countries of tropical America. For example, in Volume I the travels of Alexander von Humboldt and Aimé Bonpland in Mexico are discussed and mapped, as are those of Deppe and various entomological collectors in the country. In addition to information on other entomologists presented in Volume II, there is discussion of the initiation, publication, and collection of material for the *Biologia Centrali-Americana*. Papavero's volumes, although based primarily on secondary sources, constitute a major resource for information on naturalists in the Neotropical Region.]

PARAY, LADISLAO. 1944. *Exploración botánica de la Barranca de Tolantongo, Hidalgo.* Bol. Soc. Bot. Méx. 1: 2–6. [The Barranca de Tolantongo is ca. 50 km NE of Ixmiquilpan, Hidalgo. The author presents an account of the vegetation and species collected; photographs.]

PARAY, LADISLAO. 1946. *Exploraciones botánicas en el norte del estado de Puebla.* Bol. Soc. Bot. Méx. 4: 10–12. [An account of a collecting trip along the Puebla–Hidalgo border with descriptions of the itinerary and the plants encountered.]

PARAY, LADISLAO. 1947. *Segundo viaje a la Barranca de Tolantongo.* Bol. Soc. Bot. Méx. 5: 20–22. [A second visit to the barranca; see Paray (1944).]

PARAY, LADISLAO. 1948. *A través de la Sierra Madre Occidental.* Bol. Soc. Bot. Méx. 6: 7–13. [Description of travel in the mountains of Guerrero with the objective of botanizing the tallest peaks, El Teotepec and El Tlacotepec.]

PARAY, LADISLAO. 1949. *Exploraciones en el estado de Hidalgo.* Bol. Soc. Bot. Méx. 8: 1–7. [A description of localities visited and plants encountered during a plant-collecting trip to Hidalgo, particularly in the vicinity of San Bartolo Tutotepec; photographs.]

PARAY, LADISLAO. 1951. *Exploraciones en la Sierra de Juárez.* Bol. Soc. Bot. Méx. 13: 4–10. [Botanical travels from Oaxaca to Veracruz. Many species of plants mentioned.]

PARKER, ROBERT H. 1964. *Zoogeography and ecology of some macro-invertebrates, particularly mollusks, in the Gulf of California and the Continental Slope off Mexico.* Vidensk. Medd. Dansk Naturh. For. 126: 1–178. [Contains a brief discussion of the history of biological exploration in the Gulf of California, with particular reference to mollusk collecting (pp. 13–16). Includes reference to the U.S. Fish Commission *Albatross* Expedition, California Academy of Sciences expeditions, Templeton Crocker Expedition, Steinbeck-Ricketts Expedition, E. W. Scripps Cruise to the Gulf of California, Allan Hancock Foundation *Valero* expeditions, and Puritan-American Museum of Natural History Expedition. Some individual collectors are also mentioned.]

PARRY, CHARLES C[HRISTOPHER]. 1929. *From San Diego to the Bay of All Saints, Lower California, and back—notes of a botanist visiting Mexican soil.* Madroño 1: 218–221. [Account of a trip by Parry to Todos Santos Bay with H. C. and C. R. Orcutt, C. G. Pringle, and M. E. Jones. See: Jones (1935), DuShane (1971), and Lenz (1986) for other versions of the trip.]

PAYNTER, RAYMOND A., JR. (ed.). 1957. *Biological investigations in the Selva Lacandon, Chiapas, Mexico.* Bull. Mus. Comp. Zool. 116(4): 193–298. [In the introduction (pp. 193–198), Paynter describes the 1954 expedition of several biol-

ogists to the Selva Lacandon region. For approximately 1 1/2 months they collected plants, birds, mammals, and other animal groups in the area.]

PECK, ROBERT MCCRACKEN. 1982. *A Celebration of Birds. The Life and Art of Louis Agassiz Fuertes.* New York: Walker & Co., 178 pp. [This book is beautifully illustrated with drawings and paintings by Fuertes. In the section entitled "The Naturalist" a brief account is given of Fuertes's visit to Mexico with F. M. Chapman to study and paint birds. See: Chapman (1933) and Boynton (1956) for additional information on Fuertes's Mexican trip.]

PENNELL, F[RANCIS] W[HITTIER]. 1945. *Historical sketch*, pp. 35–48, in *Plants and Plant Science in Latin America* (F. Verdoorn, ed.), Waltham, Mass.: Chronica Botanica, 381 pp. [A historical sketch of botany in Latin America from prehistory to 1850. Among those mentioned of importance to Mexican botany, especially as collectors, are: Houstoun, Sessé and Mociño, Née and Haenke, Humboldt and Bonpland, Karwinski, Lexarza and La Llave, Lay, Berlandier, Ehrenberg, Schiede and Deppe, Sartorius, Galeotti, Ghiesbreght, Linden, Hartweg, Liebmann, Seemann, and Wislizenus. None is treated at length, but all are deftly woven into a historical context.]

PHILLIPS, ALLAN R. 1960. *La ornithología mexicana en los últimos cincuenta años.* Rev. Soc. Mex. Hist. Nat. 21: 375–389. [A good discussion of the status of ornithology in Mexico over the last 50 years with reviews of new species discovered, distributions and migrations, biology, and ecology, with an extensive bibliography. Does not contain descriptions of travel.]

PHILLIPS, JOHN C. 1911. *A year's collecting in the state of Tamaulipas, Mexico.* The Auk 28: 67–89. [Consists primarily of a list of birds collected by Frank B. Armstrong in Tamaulipas in 1908–1909. There is a brief account of Armstrong's travels in Tamaulipas, but this is mostly a description of collecting sites. An itinerary could be developed from dates and localities of birds listed.]

PURPUS, C[ARL] A[LBERT]. 1899. *Eine Succulententour nach Baja California (Mexiko).* Monatsschr. Kakteenk. 9: 33–38. [Includes an account of the wreck of the *Wahlberg*; cf. Brandegee (1900).]

PURPUS, C[ARL] A[LBERT]. 1914–1915. *Meine botanische Sammel- und Forschungsreise in Mexiko von Frühjahr bis Herbst 1912.* Möller's Deutsche Gärtn.-Zeitung 29(25): 293–297, 350, 437–442, 493–497, 509–511, 518–519, 535–537, 541–543; 30(3): 24–26, 41–42, 46–47, 55–56. [Purpus provides a detailed commentary on his botanical observations and collections in Veracruz and Puebla in 1912. The plant species and the vegetation are discussed in detail, and an itinerary can be reconstructed from the narrative (see map in Sousa, 1969, p. 6.)].

RAMÍREZ, JOSÉ. 1898–1903. *Los escritos inéditos de Martín Sessé y José Mariano Mociño.* Naturaleza, ser. 2, 3: 381–388. [A listing and description of 26 documents left by Sessé and Mociño, based on their extensive explorations in Mexico. Many of these served as the basis for the posthumously published *Plantae Novae Hispaniae* and *Plantas Mexicanas*.]

RAMÍREZ, MARÍA TERESA, AND MARIO SOUSA SÁNCHEZ. 1980. *Herbario Nacional de México—MEXU.* Inst. Biol., Univ. Nac. Autó. Méx., México, D.F., 49 pp. [Presents considerable history of collectors and development of herbaria.]

RICKETT, HAROLD WILLIAM (ed.). 1947. *The Royal Botanical Expedition to New Spain, As Described in Documents in the Archivo General de la Nación [Mexico] 1788–1820.* Chron. Bot. 11(1): 1–86. [Provides primary informa-

tion on the history of botany in Mexico for the period 1787–1820. The establishment of the Royal Botanical Garden and the travels of the Royal Botanical Expedition are discussed and mapped. Much is presented on Sessé, Mociño, Longinos Martínez, and their plant collecting in Mexico.]

RICKETT, H[AROLD] W[ILLIAM]. 1964. *Wendell Holmes Camp.* Brittonia 16: 1–10. [Biobibliography of Camp, who collected plants in Mexico; portraits.]

RODGERS, ANDREW DENNY III. 1944. *American Botany 1873–1892. Decades of Transition.* Princeton: Princeton Univ. Press, 340 pp. [Includes some discussion of travels of botanists in Mexico. Reprinted in 1968 by Hafner Publishing Co., New York.]

ROEZL, BENEDICT. 1874. *Benedict Roezl.* Gard. Chron., n.s., 2: 73, portrait. [Notes on his travels to various countries, including Mexico, to collect plants; portrait. Langman (1964) cites other references based on the information presented here. See especially: *Homage a M. Benedict Roezel*, Belgique Hort. 30: 5–12, 1880.]

ROEZL, BENEDICT. 1880. *Meine letzte Reise an der Westküste von Mexiko.* Möller's Deutsche Gärtn.-Zeitung 4: 11–12, 34–36, 58–60, 78–79, 105–108, 129–131, 154–155, 180–181, 227. [This is a rambling account of a trip begun in July 1874 by sea to New York City, by train across the United States, with several months spent in California. It was not until early December (p. 79) that Roezl set foot in Mexico at Mazatlán. Subsequent stops included Tepic and San Blas, Manzanillo and Colima (including an ascent of the Volcán de Colima), and finally (in March 1875?) a return from Manzanillo to San Francisco and from there back to Germany. Throughout the narrative Roezl refers freely to the plant life observed and the specimens collected. He had a strong interest in the fruits and vegetables cultivated in California and Mexico. The specimens collected were from time to time shipped back to Europe and often included bulbs and orchids in lots of a hundred thousand. One shipment included 22,000 specimens of a single species, *Odontoglossum cervantesii*! Other aspects of travel at the time, through the eyes of an observant European, are fully noted.]

ROOT, NINA J. 1975. *The Thomas Baillie MacDougall Collection in the American Museum of Natural History Library.* Curator 18: 276–280. [The collection includes field diaries, notebooks, specimen lists, notes on Chontal Indian customs, history, regulations, manuscripts, and miscellany, all of which are briefly described. McDougall collected mammals and plants in Oaxaca. See: Stix (1975) for additional information on MacDougall and his natural history activities and Goodman (1969) for a gazetteer.]

ROSE, J[OSEPH] N[ELSON]. 1897. *Studies on Mexican and Central American plants.* Contr. U.S. Natl. Herb. 5(3): 109–144. [See next entry.]

ROSE, J[OSEPH] N[ELSON]. 1899. *Studies on Mexican and Central American plants–No. 2.* Contr. U.S. Natl. Herb. 5(4): 145–259. [Rose's 1897 and 1899 papers are not travel accounts, but a great deal of information may be gleaned from them about collection localities of many early plant collectors in Mexico, including Rose, E. W. Nelson, E. Palmer, C. G. Pringle, and others. There is also some interesting information on the uses of plants.]

ROSE, J[OSEPH] N[ELSON]. 1911. *Exploration in Lower California.* J. New York Bot. Gard. 12(144): 263–272. [Rose accompanied an expedition on the *Albatross* to Baja California, February–April, 1911, where many islands were visited. Rose was then especially interested in cacti but other plants were also collected. A detailed itinerary is provided.]

ROSENGARTEN, FREDERIC, JR. 1991. *Wilson Popenoe. Agricultural Explorer, Educator, and Friend of Latin America.* Lawai, Kauai, Hawaii: National Tropical Botanical Garden, 182 pp. [Account of travels in Latin America, including Mexico, in search of useful plants for introduction to the United States. The Mexican travels described took place in 1918. Popenoe was later active in agricultural and horticultural pursuits in Central America.]

ROVIROSA, J[OSÉ] N[ARCISO]. 1889. *Vida y trabajos del naturalista Belga Augusto B. (Bonifacio) Ghiesbreght, explorador de México.* Naturaleza, ser. 2, 1: 211–217. [According to Langman (1964), this paper "Includes a description of his journeys, the regions explored, and lists of important plants added to the flora."]

RUSBY, H[ENRY] H[URD]. 1890. *A biographical sketch of Dr. George Thurber.* Bull. Torrey Bot. Club. 17(7): 204–210. [Thurber collected Mexican plants while being associated with the U.S.–Mexican Boundary Survey.]

RZEDOWSKI, J[ERZY]. 1959. *Las colecciones botánicas de Wilhelm (José Guillermo) Schaffner en San Luis Potosí.* I. Acta Ci. Potos. 3: 99–121. [A brief biographical account of Wilhelm Schaffner (1830–1882) together with a discussion of the plants he collected and the (sometimes problematical) localities where they were collected, as well as of ambiguities in collection numbers.]

RZEDOWSKI, J[ERZY]. 1965. *Maximino Martínez (1888–1964).* Taxon 149(6): 173–178. [Biobibliography of Martínez, a Mexican botanist.]

RZEDOWSKI, J[ERZY]. 1966a. *Datos biográficos de Faustino Miranda.* Ciencia (Mexico). 24: 171–175. [Biographical account of one of the giants in Mexican botany. Miranda collected widely in Mexico, especially in Chiapas. A list of his principal publications is included.]

RZEDOWSKI, JERZY. 1966b. *Vegetación del Estado de San Luis Potosí.* Contr. Inst. Inv. Zonas Desérticas, Univ. Autó. San Luis Potosí, 20, 291 pp. [A history of the study of plants of San Luis Potosí is included.]

RZEDOWSKI, J[ERZY]. 1967. *Faustino Miranda 1905–1964.* Brittonia 19(1): 95–98. [Essentially an English translation of the 1966a article.]

RZEDOWSKI, JERZY. 1969. *Maximino Martínez (1888–1964).* Bol. Soc. Bot. Méx. 30: 23. [Biographical information on this important Mexican botanist.]

RZEDOWSKI, J[ERZY]. 1981. *Un siglo de la botánica en México.* Bol. Soc. Bot. Méx. 40: 1–14. [A history of botany in Mexico with portraits of several plant collectors: J. N. Rovirosa, C. Conzatti, C. Reiche, M. Martínez, and F. Miranda.]

RZEDOWSKI, JERZY. 1983. *Vegetación de México.* México, D.F.: Edit. Limusa, 432 pp. [Contains a history of botanical study in Mexico, pp. 13–20.]

RZEDOWSKI, JERZY, AND GRACIELA CALDERÓN DE RZEDOWSKI. 1989. *Transisthmic Mexico (Campeche, Chiapas, Quintana Roo, Tabasco and Yucatán),* pp. 270–280, in *Floristic Inventory of Tropical Countries* (D. G. Campbell and H. D. Hammond, eds.), New York Bot. Gard., 545 pp. [In section "Important Collectors" the history of plant collecting in the area is briefly discussed.]

SÁNCHEZ-MEJORADA, HERNANDO. 1958. *Relación de una excursión a Oaxaca.* Cact. Suc. Mex. 3(3): 36–39. [A brief account of a cactus-collecting trip from Mexico City to Tehuantepec, by way of Tehuacán and Oaxaca, and return. Accompanying the author were Charlie Mieg, George Lindsay ("El Grandísimo"), and Reid Moran. Specific localities visited and plants observed (and collected ?) are noted.]

SANDERSON, IVAN T. 1941. *Living Treasure.* New York: Viking Press, 290 pp. [One of Sanderson's three "Treasure" books. Three chapters of this book are devoted to descriptions of his travels and observations on animals in Yucatán. An interesting narrative by a well-known nature writer.]

SARTON, GEORGE. 1943. *Aimé Bonpland.* Isis 34(5): 385–395. [Biography of Bonpland, companion of Alexander von Humboldt during the latter's travels in South America and Mexico. Bonpland was in charge of most of the plant collecting during this famous expedition. Reprinted: pp. 127–139, in Stearn, William T., ed. (1968).]

SARTORIUS, C[HRISTIAN] [WILHELM]. 1858. *Mexico. Landscapes and Popular Sketches* (Dr. Gaspey, ed.). London: Trubner & Cie., 202 pp. [A general description of Mexico, including the social system, economy, agriculture, vegetation, and much on various natural history subjects. The various regions of the country are described: savannah, prairie, evergreen forest, highland, coastal, etc. There are also some travel accounts.]

SCHIEDE, C[HRISTIAN] J[ULIUS] W[ILHELM]. 1829, 1830. *Botanische Berichte aus Mexiko, mitgetheilt vom Dr. Schiede (aus Briefen an den Herausgeber): 1829. Erster Bericht über die Vegetation um Veracruz und über die Reise von dort nach Jalapa*, Linnaea 4: 205–212. 1829. *Zweiter Bericht über die Gegend um Jalapa und Excursion auf den Volcán de Orizaba*, Linnaea 4: 212–236. 1829. *Dritter Bericht über die Gegend von Papantla und Misantla und über die Reise von Jalapa dorthin und zurück*, Linnaea 4: 554–538. 1830. *Vierter Bericht. Excursionen in der Gegend von Jalapa und Reise von dort nach Mexico,* Linnaea 5: 463–477. [Describes travels by Schiede (sometimes with Ferdinand Deppe), primarily in Veracruz, quoting letters from Schiede to D. F. L. Schlechtendal. There is considerable description of the vegetation and of particular species of plants encountered. See also Langman (1964) for additional bibliographical information on these papers. As an extended description of the publication, Langman may be quoted, "The letters sent to Schlechtendal in Berlin describe the regions around Veracruz, Jalapa, Orizaba, Papantla, Tecolutla, and Misantla and cover trips taken with Deppe from Nov. 28, 1828 to Feb. 1829."]

SCHOENMAN, THEODORE, AND HELEN BENEDEK SCHOENMAN (1976). See: Xántus (1976).

SCHUETZ, BOHUMIL. 1970. *A. V. Fric, famous cactus hunter.* Cact. Succ. J. 42: 130–132, 147, 161–162, 235–238. [Biographical information on and travels of A. V. Fric, who collected cacti in Mexico.]

SCHWARZ, FRITZ. 1939. *Our cactus hunting.* Cact. Succ. J. 10: 203–204. [Describes a short trip to collect cacti in Mexico, probably near the city of San Luis Potosí. No locality is given, but Schwarz gives his address as San Luis Potosí.]

SCLATER, PHILIP LUTLEY. 1858. *On a collection of birds received by M. Auguste Sallé from Oaxaca in Southern Mexico.* Proc. Zool. Soc. London, Pt. 26: 294–305. [Contains brief account of Adolphe Boucard's collecting localities in Oaxaca. Also mentions M. Botteri and R. Montes de Oca as collectors in Oaxaca. More may be found on Boucard's bird collecting in: Sclater, P. L. 1859. Proc. Zool. Soc. London, Pt. 27: 369–393; and Sclater, P. L. 1862. Proc. Zool. Soc. London 1862: 18–20.]

SEEMANN, BERTHOLD. 1853. *Notices about Matteo Botteri.* Bonplandia 1: 143. [Brief note about Botteri's collecting in Mexico.]

SEEMANN, BERTHOLD. 1856. *Flora of North-Western Mexico*, pp. 255–320, in *The Botany of the Voyage of H. M. S. Herald Under the Command of Captain Henry Kellett During the Years 1845–51*. London. [Seemann discussed his travels in northwestern Mexico in 1848–1850 while collecting plants as part of two *H. M. S. Herald* expeditions. He traveled and collected extensively between the coast and Durango. Seemann also reviewed briefly the visits and collections made during the *H. M. S. Blossom* (1827–1828) and *H. M. S. Sulphur* (1837–1838) voyages to the area. See: Stafleu and Cowan (1985, vol. 5, pp. 476–77), and Langman (1964) for bibliographical details on publication and further discussion of the *H. M. S. Herald* voyage.]

SELANDER, RICHARD B., AND PATRICIA VAURIE. 1962. *A gazetteer to accompany the "Insecta" volumes of the Biologia Centrali-Americana.* Amer. Mus. Novit. no. 2909. pp. 1–70. [A useful gazetteer for insect localities cited in the *Biologia*; should also be helpful for other groups of organisms covered in the series since many of these were collected at the same localities as the insects. A brief history is also presented on the collection of material and publication of the *Biologia*.]

SELANDER, ROBERT K[EITH], RICHARD F. JOHNSTON, B. J. WILKS, AND GERALD S. RAUN. 1962. *Vertebrates from barrier islands, Tamaulipas.* Univ. Kansas Publ. Mus. Nat. Hist. 12(7): 309–345. [Presents a brief account of a trip to the area in 1961. Also reviews some of the history of collecting of vertebrates in the region.]

SELER, CAECILIE. 1900. *Auf alten Wegen in Mexiko und Guatemala.* Berlin: Dietrich Reimer (Ernst Vohsen), 363 pp + map. [Travelogue of C. and E. Seler, archeologists/anthropologists who also collected plants; map of travels.]

SELER-SACHS, CAECILIE. 1925. *Auf alten Wegen in Mexiko und Guatemala*, 2nd ed. Stuttgart: Strecken und Schröder, 362 pp + map.

SELER, EDUARD. 1897. *Über seine Reisen in Mexico und Guatemala.* Verh. Ges. Erdk. Berlin 24: 397–413. [A rambling but engaging account of travels in Oaxaca, Chiapas, and Guatemala in 1895–1896. The terrain and the people are well described, but minimal attention is given to the natural history of the area. Nevertheless, an itinerary can be reconstructed from the account as an aid in establishing localities for the botanical (and other ?) collections made by E. and C. Seler.]

SETCHELL, WILLIAM ALBERT. 1926. *Townshend Stith Brandegee and Mary Katharine (Layne) (Curran) Brandegee.* Univ. Calif. Publ. Bot. 13(9): 155–178. [Biographical. A letter is included in which T. S. Brandegee briefly describes his botanizing trips to Baja California, and to the states of Sonora, Sinaloa, Puebla, Veracruz, and other areas in Mexico. His first trip to Baja California was made in 1889. Katharine Brandegee accompanied her husband and Gustav Eisen to the Cape Region in 1893. The publications of the Brandegees are listed.]

SHAW, ELIZABETH A. 1987. *Charles Wright on the Boundary, 1849–1852 or Plantae Wrightianae Revisited.* Westport: Meckler Publishing Co., 44 pp., including map of travels. [This book includes information on Charles Wright and his travels along the United States–Mexico border collecting plants as part of the Boundary Commission. Some collections were made in northern Sonora and Chihuahua. Wright's itineraries and three microfiches of Wright's field lists are also included.]

SIMPSON, LESLEY BYRD. 1938. *California in 1792. The Expedition of José Longinos Martínez.* Huntington Library Publ., 114 pp. [Translated excerpts from journal of Longinos's travels in Baja California; treats subject of natural history broadly.]

SIMPSON, LESLEY BYRD. 1940. *The story of José Longinos Martínez, California's first naturalist.* Hispanic Amer. Hist. Rev. 20(4): 643–649. [After publication of Simpson's 1938 book, additional information was found that further explains the discord in the Botanical Expedition of 1787 between Longinos, Sessé, and others which resulted in Longinos being sent to explore Baja California.]

SIMPSON, LESLEY BYRD (ed.). 1961. *Journal of José Longinos Martínez: Notes and Observations of the Naturalist of the Botanical Expedition in Old and New California and the South Coast 1791–1792.* San Francisco: John Howell Books, 114 pp. [Longinos described plants, animals, minerals, and people encountered during his travels in Baja California. There is a detailed itinerary. The editor discusses questions about Longinos's veracity and the many discrepancies in the journal.]

SKUTCH, ALEXANDER F. 1977. *A Bird Watcher's Adventures in Tropical America.* Austin: Univ. Texas Press, 327 pp. [An interesting account of birds and country observed during a train trip from Veracruz to the Guatemalan border in 1934. Skutch was on his way to Central America to collect plants. He later wrote many books on the birds of tropical America.]

SLEVIN, JOSEPH R[ICHARD]. 1923. *Expedition of the California Academy of Sciences to the Gulf of California in 1921. General account.* Proc. Calif. Acad. Sci., ser. 4, 12(6): 55–72. [Expedition of over 2 1/2 months to Baja California, islands in the Gulf of California, and to mainland Mexico to collect and study flora and fauna of the area. Several biologists, representing a broad diversity of interests, were on the trip. Maps and a detailed itinerary are provided.]

SLEVIN, JOSEPH R[ICHARD]. 1931. *Log of the schooner "Academy" on a voyage of scientific research to the Galápagos Islands, 1905–1906.* Occ. Pap. Calif. Acad. Sci., No. 17, 162 pp. [Expedition members collected briefly around Ensenada and on various islands off the west coast of Baja California while on their way to the Galápagos Islands. Naturalists on the expedition included F. X. Williams, E. W. Gifford, J. S. Hunter, A. Stewart, J. R. Slevin, and E. S. King.]

SMITH, ALAN R. 1981. *Pteridophytes*, pt. 2, in *Flora of Chiapas* (D. E. Breedlove, ed.), California Acad. Sci., 370 pp. [Includes a section "History of pteridophyte collecting in Chiapas." Collections of Jean Jules Linden, Auguste Ghiesbreght, José Rovirosa, Carl Albert Purpus, Eizi Matuda, and Dennis E. Breedlove are mentioned.]

SMITH, HOBART M[UIR]. 1975. *The blazing of a trail: The scientific career of Edward Harrison Taylor.* Mus. Nat. Hist. Univ. Kansas Monogr. 4: 115–144. [Includes some remarks (pp. 128–129) about Taylor's travels in Mexico collecting reptiles.]

SMITH, HOBART M[UIR], AND EDWARD H. TAYLOR. 1950. *An annotated checklist and key to the reptiles of Mexico–exclusive of the snakes.* Bull. U.S. Natl. Mus. 199: 1–253. [Itinerary and gazetteer for the Walther Rathbone Bacon Expedition, 1938–1941, pp. 4–11. A brief itinerary is presented for H. M. and R. B.

Smith, and at times E. H. Taylor, in Mexico in search of reptiles. A list of the localities at which they collected in 18 Mexican states is also included.]

SMITH, HOBART M[UIR], AND MRS. [ROZELLA B.] SMITH. 1941. *Collecting Mexican reptiles and amphibians.* Explorations and Field-Work of the Smithsonian Institution in 1940, Publ. 3631, pp. 35–38. [The Smiths collected over 20,000 reptiles and amphibians in a period of about two years over a broad area of Mexico.]

SMITH, HOBART M[UIR], AND ROZELLA B. SMITH. 1969. *Early Foundations of Mexican Herpetology. An Annotated and Indexed Bibliography of the Herpetological Publications of Alfredo Dugès, 1826–1910.* Urbana: Univ. Illinois Press, 85 pp. [Biobibliography of Dugès, the "father of Mexican herpetology," with an index to the genus and species-group names mentioned in his writings. Dugès was also a significant collector of plants and other animals.]

SMITH, HOBART M[UIR], AND ROZELLA B. SMITH. 1973. *Synopsis of the Herpetological Fauna of Mexico.* Vol. 2. *Analysis of the Literature Exclusive of the Mexican Axolotl.* North Bennington, Vermont: John Johnson Natural History Books, 367 pp. [In the "Historical Account" the authors present a review of Mexican herpetology with information on publications, collecting, and collectors. See especially for information on Francisco Hernández, his travels, and his manuscripts.]

SOMOLINOS D'ARDOIS, GERMÁN. 1951. *El viaje del Doctor Francisco Hernández por la Nueva España.* Anal. Inst. Biol. Méx. 22: 435–484, map. [The travels of the 16th century naturalist in Mexico are discussed in detail and six maps of his probable itineraries are presented. An appendix provides a gazetteer of Hernández's localities and identification with modern names and appropriate commentary.]

SOSA, FRANCISCO. 1885–1886a. *Biografías de naturalistas mexicanos. Don Pablo de la Llave.* Naturaleza 7: 79–81 [Brief biographical account of Pablo de la Llave (1773–1833), theologian, botanist, and administrator, who was at one time Director of the Botanical Garden in Madrid and was later imprisoned as a political dissident. He arrived in Mexico in 1823, where he spent the rest of his life. His contributions to natural history are briefly discussed.]

SOSA, FRANCISCO. 1885–1886b. *Biografías de naturalistas mexicanos. Don José Mariano Mociño.* Naturaleza 7: 113–116. [Brief biographical account of Mociño, collaborator with Martín Sessé in the botanical exploration of Mexico (1795–1804) and his return to Spain with the results of these explorations—manuscripts, a herbarium, and ca. 1,000 drawings and paintings. The important and complicated history of these drawings is briefly but fully recounted.]

SOUSA S., MARIO. 1969. *Las colecciones botánicas de C. A. Purpus en México, período 1898–1925.* Univ. Calif. Publ. Bot. 51: 1–36. [Biography, travels, and plant collections of Purpus in Mexico. Collecting routes and areas are mapped and an annotated list of localities is provided.]

SOUSA S., MARIO. 1979. *Itinerario botánico de G. Andrieux en México.* Taxon 28: 97–102. [Andrieux's botanical itinerary of 1834 is presented and his travel routes mapped. The localities of his collections are indexed.]

SPENCER, MARJORIE. 1930. *The botanical quest of a woman in Latin America.* Pan. Amer. Mag. 42: 389–391. [About Ynés Mexia.]

SPIETH, HERMAN T. 1950. *The David Rockefeller Mexican expedition of the American Museum of Natural History. Introductory account.* Amer. Mus. Novit. No. 1454, 67 pp. [During the period June 24 to August 24, 1947, five biologists under the auspices of the American Museum of Natural History collected insects and spiders in the north-central plateau area of Mexico, in the states of Chihuahua, Durango, Zacatecas, and Coahuila. This is a well-illustrated travel account. Scientists on the trip included: Mont A. Cazier, Charles D. Michener, Willis J. Gertsch, Rudolf Schramel, and Herman T. Spieth.]

SPOONER, DAVID M., JOHN BAMBERG, J. PETER HJERTING, AND JOSÉ GÓMEZ. 1991. *Mexico, 1988 potato germplasm collecting expedition and utility of the Mexican potato species.* Amer. Potato J. 68: 29–43. [A map of the routes traveled (from Sinaloa and Baja California to Oaxaca) is presented but little specific information on collecting localities is included; the discussion is primarily on the nature and value of the germplasm collected.]

SPRAGUE, T[HOMAS] A[RCHIBALD]. 1924. *Humboldt and Bonpland's Mexican itinerary.* Kew Bull. 1: 20–27. [Reprinted, pp. 95–98, in W. T. Stearn (1968).]

SPRAGUE, T[HOMAS] A[RCHIBALD]. 1926. *Sessé and Mociño's Plantae Novae Hispaniae and Flora Mexicana.* Kew Bull. 9: 417–425. [Presents the historical background to the Royal Expedition to New Spain (Mexico) headed by Sessé and Mociño and of the subsequent, posthumous publication of *Plantae Novae Hispaniae* and *Flora Mexicana.* A section is included on "Sessé and Mociño's Mexican localities," with a listing indicating the state in which each is found, which is important inasmuch as many of the locality names used by Sessé and Mociño are no longer in use.]

STAFLEU, FRANS A., AND RICHARD S. COWAN. 1976–1988. *Taxonomic Literature, A Selective Guide to Botanical Publications and Collections With Dates, Commentaries, and Types.* Utrecht: Bohn, Scheltema & Holkema. 7 vols. [This is a primary source of bibliographical information on botanical taxonomic publications of truly staggering scope, far too great to comment on here. From the point of view of natural history collections, information is provided on the herbaria of deposit of individual scientist's collections; also a key to the primary literature (including biographies) for each entry is provided. The individual volumes, pages, alphabetical coverage, and dates of publication are: 1: 1136, A–G (1976); 2: 991, H–Le (1979); 3: 980, Lh–O (1981); 4: 1214, P–Sak (1983); 5: 1066, Sal–Ste (1985); 6: 926, Sti–Vuy (1986); 7: 653, W–Z (1988).]

STAGER, KENNETH E. 1954. *Birds of the Barranca de Cobre region of southwestern Chihuahua, Mexico.* The Condor 56(1): 21–32. [This is mostly a list of birds of the area with taxonomic, behavorial, and ecological notes, but there is also a brief account of the author's travel to the area May 7–30, 1950, as well as a review of previous field studies there.]

STANDLEY, PAUL C[ARPENTER]. 1920. *Trees and Shrubs of Mexico.* Part 1. Contr. U.S. Natl. Herb. 23 (1): 1–169. [Provides a section on the early history of botanical exploration in Mexico, pp. 8–19, citing the contributions of Francisco Hernández, Sessé and Mociño, Humboldt, and others. Biographical data on many botanical collectors are also presented as footnotes throughout this work.]

STANDLEY, PAUL C[ARPENTER]. 1927. *A counterfeit collection of Mexican plants falsely attributed to Brother G. Arsène.* Science 65: 130–133.

STANDLEY, PAUL C[ARPENTER]. 1930. *Flora of Yucatan*. Field Mus. Nat. Hist. Publ. Bot. Ser. 3(3): 157–492. [Reviews the botanical exploration of the Yucatan Peninsula, including work of collectors William Houstoun, Jean Jules Linden, Eduard and Caecilie Seler, Arthur Schott, Charles F. Millspaugh, George F. Gaumer, and others.]

STARLING, R. J. 1988. *Through Baja California with Dr. Lau*. Brit. Cact. Succ. J., pt. 1, 6(2): 41–43; pt. 2, 6(3): 66–69. [Narrative of travel with A. B. Lau in Baja California and mainland Mexico to collect cacti, with routes and localities; photographs.]

STEARN, WILLIAM T. (ed.) 1968. *Humboldt, Bonpland, Kunth, and Tropical American Botany. A Miscellany of the "Nova Genera et Species Plantarum."* Lehre: J. Cramer, 159 pp. [This publication contains a series of contributions on the travels and contributions of Humboldt and Bonpland and publication of the multivolume *Nova Genera et Species Plantarum* (1816–1825). Their travels in Mexico are covered by reprinting an article by T. A. Sprague on this subject, which was published in 1924 in *Kew Bulletin*.]

STEELE, ARTHUR ROBERT. 1964. *Flowers for the King. The Expedition of Ruiz and Pavón and the Flora of Peru*. Durham, North Carolina: Duke Univ. Press, 378 pp. [In the introductory portion of this book Steele presents a brief history of botanical exploration, including that of Francisco Hernández in Mexico and the problems of publication of his manuscripts (pp. 5–7). See especially footnote on p. 7 for modern editions of Hernández's work and additional biobibliographical materials.]

STEINBECK, JOHN. 1951. *The Log from the Sea of Cortez*. New York: Viking Press, 282 pp. [This is the narrative portion of *The Sea of Cortez* (Steinbeck & Ricketts 1941). There is also an extensive profile of E. F. Ricketts. The log has been reprinted several times by Viking Press and Penguin Books. See also: Hedgpeth (1978).]

STEINBECK, JOHN, AND EDWARD F. RICKETTS. 1941. *Sea of Cortez. A Leisurely Journal of Travel and Research*. New York: Viking Press, 598 pp. [Much is presented here on natural history, mainly about marine invertebrates. There is an appendix listing species collected and other biological notes and an extensive annotated bibliography, including references to general collecting in Baja California. This book was reprinted by Paul P. Appel, Publisher, in 1971 and 1982. See Hedgpeth (1978) for additional information on this expedition.]

STERLING, KIER B. 1991. *Two pioneering American mammalogists in Mexico: the field investigations of Edward William Nelson and Edward Alphonso Goldman, 1892–1906*, pp. 33–47, in *Latin American Mammalogy. History, Biodiversity and Conservation* (M. A. Mares and D. J. Schmidly, eds.), Norman: Univ. Oklahoma Press, 468 pp. [An excellent overview of the travels and collections of Nelson and Goldman in Mexico; several interesting photographs. See "Literature Cited" section for published papers and archival materials on these two naturalists. Also see: Goldman (1951) for extended account of their travels in Mexico, including a gazetteer.]

STEVENS M., RAYFRED L. 1956. *La Obra de Alexander von Humboldt en Mexico*. Inst. Panamericano Geog. Hist., Publ. No. 202, 269 pp. [A comprehensive study of Humboldt in Mexico, including his travels, cartography, study of vegetation, and biographical information. Maps are included of Humboldt's travels in the country.]

STIEBER, MICHAEL T. 1982. *Register of plant collectors' field notes held in North American institutions*. Huntia 4(3): 151–202. [The locations of field notes of "over 600" plant collectors are included. There is a list of collectors keyed to the institutions holding their field notes, and also a list of repositories and the field note collections they hold. The field notes of many who collected plants in Mexico are indexed here. This is an important source for information on unpublished travels and collecting notes.]

STIX, JUDITH S. 1974. *"Yo soy botánico."* Cact. Succ. J. 46: 117–119. [Brief biographical account of Thomas Ballie MacDougall and his travels and collecting in Mexico; photograph.]

STIX, JUDITH S. 1975. *Thomas Baillie MacDougall—naturalist and collector.* Curator 18(4): 270–276. [Biography, portrait. MacDougall had broad interests in natural history, ethnology, and archeology; collected mammals and plants in Oaxaca and Chiapas. See Goodman (1969) for gazetteer of collecting localities, and Root (1975) for archival materials on MacDougall.]

STRESEMANN, ERWIN. 1954. *Ferdinand Deppe's travels in Mexico, 1824–1829.* The Condor 56: 86–92. [Contains a narrative of Deppe's travels in Mexico to collect birds; with a list of species he collected on which descriptions are based.]

STRESEMANN, ERWIN. 1975. *Ornithology from Aristotle to the Present.* Cambridge: Harvard Univ. Press, 432 pp. [This book was first published, in 1951, as *Die Entwicklung der Ornithologie von Aristotles bis zur Gegenwart.* Little is presented on the history of ornithology in Mexico, but see pp. 31–32 for a discussion of the fate of Francisco Hernández's manuscripts in which the first descriptions and illustrations of Mexican birds appeared. According to Stresemann, Georges Cuvier stated that Hernández's book was almost the only work on the natural history of Mexico to have appeared up to that time (1825).]

STROUD, PATRICIA TYSON. 1992. *Thomas Say. New World Naturalist.* Philadelphia: Univ. Pennsylvania Press, 340 pp. [An extensive biography of Thomas Say, including his travel and collecting activities in Mexico in 1828. See also: Weiss and Ziegler (1931) for earlier book-length biography of Say, and Barber (1928) for Say's travels in Mexico.]

SUTTON, GEORGE MIKSCH. 1951. *Mexican Birds. First Impressions. Based Upon an Ornithological Expedition to Tamaulipas, Nuevo León, and Coahuila With an Appendix Briefly Describing all Mexican Birds.* Norman: Univ. Oklahoma Press, 282 pp. [Sutton describes his travel by automobile to study birds of northern Mexico. The trip took place from "latter January to early March" in either 1948 or 1949. This is a beautifully done book with considerable narrative, a great deal of information on birds, and a profusion of illustrations by the author, including many color paintings.]

SUTTON, GEORGE MIKSCH. 1972. *At a Bend in a Mexican River.* New York: Paul S. Eriksson, Inc., 184 pp. [Sutton describes three of the many ornithological expeditions that he made to Mexico. The first trip was to the Río Sabinas area in southern Tamaulipas in 1941. The second covers a trip from the Rio Grande River in Texas to the Río Balsas in the state of Michoacán in 1948–1949. The third took place in 1951–1952 to a locality in southern San Luis Potosí. Illustrated with photographs and some of Sutton's bird paintings.]

SZYSZLO, VITOLD DE. 1913. *Dix Mille Kilometres a Travers le Mexique.* Paris: Librairie Plon, 343 pp. [A general travel account with description of the vegetation,

agriculture, economics, social system, climate, and topography. Covers southcentral and western Mexico, including Baja California.]

TATE, JOYCE L. 1969. *California gardens: The Howard E. Gates Memorial Cactus and Succulent Garden.* Cact. Succ. J. 41(3): 112–116. [Contains considerable biographical information on Howard Gates, who collected cacti extensively in Mexico and wrote many articles on cacti and succulents of Baja California.]

TAYLOR, WALTER P., WALTER B. MCDOUGALL, CLIFFORD C. PRESNAL, AND KARL P. SCHMIDT. 1946. *The Sierra del Carmen in northern Coahuila. A preliminary ecological survey.* Texas Geogr. Mag. 10(1): 11–22. [Narrative of a ten-day trip by a group of biologists travelling by horseback in 1945 to examine the topography and natural history of the part of the Sierra del Carmen range in Mexico adjacent to the Big Bend National Park in Texas. This interesting account of the area describes the vegetation and animal life. The route is mapped and photographs are included.]

TEGELBERG, GILBERT F. 1939. *Collecting cacti in Lower California.* Cact. Succ. J. 11(3): 35–37. [Narrative of a cactus-collecting trip to Baja California with Howard Gates; photographs.]

TERRA, HELMUT DE. 1955. *Humboldt. The Life and Times of Alexander von Humboldt, 1769–1859.* New York: Alfred A. Knopf, 386 pp. [The travels of Humboldt in Mexico are described in the chapter "The Challenge of Mexican Pyramids and Volcanoes." The route of his travels in Mexico during the years 1803–1804 is mapped. There is an excellent bibliography on Humboldt.]

THOMAS, JOHN H. 1969. *Botanical exploration in Washington, Oregon, California, and adjacent areas.* Huntia 3: 5–62. [Marginally of interest to the history of Mexican botany because several of the plant collectors mentioned worked in Mexico. Several portraits are included.]

TINKER, BEN. 1978. *Mexican Wilderness and Wildlife.* Austin: Univ. Texas Press, 131 pp. [Ben Tinker, hunter-naturalist, writes about experiences gained through many years of wandering about in the Sierra Madre country of northern Mexico and in Baja California, and making observations on large game and predator animals. This book contains an interesting mixture of travel, descriptions of the country, and observations on large animals.]

TOWER, W. L. 1905. [*Collecting insects in southern Mexico.*] Entomol. News 16: 31–32. [Brief account of collecting about 36 kms southeast of Mt. Orizaba.]

TOWNSEND, CHARLES HASKINS. 1916. *Voyage of the Albatross in the Gulf of California in 1911.* Bull. Amer. Mus. Nat. Hist. 35: 399–476. [This expedition was sponsored by several institutions in the United States. During the two month's voyage, collections were made on the Baja California peninsula as well as on islands off the west coast of Baja and in the Gulf of California. In addition to the narrative account of the expedition, considerable information is presented on climatic and hydrographic conditions and dredging operations. Collecting stations are listed and the route is mapped. Large numbers of marine and terrestrial organisms were collected. See also Steinbeck and Ricketts (1941, p. 586) for summary of voyage.]

TOWNSEND, CHARLES HENRY TYLER. 1897. *On the biogeography of Mexico and the southwestern United States II.* Trans. Texas Acad. Sci. 2(1): 33–86. [During the course of study of the biogeography of Mexico, Townsend, an entomologist, described (pp. 33–50) his visits in 1895–1896 to various parts

of the country. His route was along the east coast into the Yucatan Peninsula and south to the Isthmus of Tehuantepec. Insects, mollusks, and plants collected are listed. Townsend published several papers on Mexican insects during the period 1892–1912.]

URBAN, EMIL K. 1959. *Birds of Coahuila, México*. Univ. Kansas Publ. Mus. Nat. Hist. 11(8): 443–516. [Lists the names of 22 persons who collected birds in the state of Coahuila for the University of Kansas Museum of Natural History. No other history of bird collecting in Coahuila is presented.]

URBAN, IGNATZ. 1897. *Carl August Ehrenberg (1801–1849)*. Bot. Jahrb. Syst. 24 (Beibl. 58): 1–13. [Ehrenberg collected plants in Mexico between 1831 and 1840. About 800 collections were made traveling between Veracruz and Mexico City and another 1200 collections in the vicinity of Real del Monte, Hidalgo. These collections were interpreted by Schlechtendal in a series of publications (Linnaea vols. 11–18), which are cited.]

USINGER, ROBERT LESLIE. 1972. *Robert Leslie Usinger: Autobiography of an Entomologist*. San Francisco: Pacific Coast Entomol. Soc., 330 pp. [Describes a visit to Temascaltepec, in the state of Mexico, with Howard E. Hinton in 1933, where they made extensive insect collections.]

VAURIE, PATRICIA, AND CHARLES VAURIE. 1953. *Collecting in Sonora, Mexico, including Tiburon Island*. J. New York Entomol Soc. 61: 79–91. [Describes travels of the authors from August 1–August 16, 1952, for the purpose of collecting insects and spiders. Includes map showing collecting localities from Nogales south to Alamos in Sonora.]

VERBISCAR, ANTHONY J. 1993. *Howard Scott Gentry, December 10, 1903–April 1, 1993*. Econ. Bot. 47(3): 335–337. [Obituary of a longtime collector and student of plants of Mexico; photograph. For some of Gentry's travels and writings on plants of the country see his publications (1942, 1946a, b) and Cunningham (1994).]

VERDOORN, FRANS. 1941. *Botanical collectors in Latin American countries. (Preliminary list)*. Chron. Bot. 6(8): 171–172. [Twenty-four plant collectors in Mexico are listed. The states and areas in which they collected are included.]

VERDOORN, FRANS (ed.) 1945a. *Plants and Plant Science in Latin America*. Waltham, Massachusetts: Chronica Botanica Co., 381 pp. [This important publication contains a series of articles by various authors dealing with many aspects of plant study in Latin America. For contributions of special interest to exploration and plant study in Mexico see the following: Lanjouw (1945), Pennell (1945), and Verdoorn (1945b).]

VERDOORN, FRANS. 1945b. *A selected list of travel books of botanical interest*, pp. xxiii-xxviii, in *Plants and Plant Science in Latin America* (F. Verdoorn, ed.), Waltham, Massachusetts: Chronica Botanica, 381 pp. [An excellent, partially annotated list of books about travel of naturalists, principally botanists, in Latin America. Several of the entries pertain to Mexico. Joseph Ewan (Archives Natural History 19(2): 185–207, 1992), in an article on travel narratives of naturalists in the Amazon, states that Verdoorn's is the best list of travel accounts of botanical interest.]

VON HAGEN, VICTOR W. 1944. *Francisco Hernández: Naturalist. 1515–1578*. Sci. Monthly 58: 383–385. [The explorations (1570–1576) of Hernández and the fate of his writings on the natural history of Mexico are briefly discussed. Von Hagen considered Hernández to be the first American natu-

ralist and praised his broad accomplishments in study of the botany (especially ethnobotany) and zoology of Mexico. It was not until 1651 that an abridged version of Hernández's 16 original manuscript volumes was published. The original volumes were destroyed in a fire in 1671.]

WALTHER, ERIC. 1935–1936. *Collecting succulents in Mexico*. Cact. Succ. J. (1935) 6: 137–140, 149–151, 163–165, 185–189; 7(9): 137, 166–168,182–184; (1936) 8: 18–21, 70–72. [Travel in southcentral Mexico to study plants of the genus *Echeveria;* photographs.]

WAUER, ROLAND H. 1992. *A Naturalist's Mexico*. College Station: Texas A&M Univ. Press, 304 pp. [An ornithologist's view of the natural history of Mexico based on many trips covering every state in the country. This is an excellent mixture of travel accounts and description of the flora, fauna, and topography of some of the most interesting and important natural areas of Mexico. Illustrated with photographs and maps.]

WEBER, WALTER A. 1945. *Wildlife in Tabasco and Veracruz*. Natl. Geogr. Mag. 87(2): 187–216. [Describes experiences collecting and observing animals around La Venta, Tabasco, and in adjacent Veracruz in 1943, as part of a National Geographic Society and Smithsonian Institution expedition. Beautifully illustrated with the author's bird and mammal paintings; photographs.]

WEISS, HARRY B., AND GRACE M. ZIEGLER. 1931. *Thomas Say, Early American Naturalist.* Springfield, Illinois: Charles C. Thomas, 260 pp. [This biography of Say includes a brief discussion of his trip to Mexico in 1827–1828. Say collected at Jalapa, Mexico City, Veracruz, and Tacuba. This title was reprinted by Arno Press in 1978. See also: Stroud (1992), and Barber (1928).]

WELLBAUM, MILDRED. 1963. *Mexico sidelights.* Cact. Succ. J. 35(2): 53–56. [A travelogue, mostly on the Central Plateau, in search of cacti.]

WETMORE, [FRANK] ALEXANDER. 1940. *An ornithologist in southern Mexico.* Explorations and Field-Work of Smithsonian Institution in 1939. Publ. 3586, pp. 31–36. [Account of travel to collect birds in Veracruz.]

WETMORE, [FRANK] ALEXANDER. 1943. *The birds of southern Veracruz, Mexico.* Proc. U.S. Natl. Mus. 93: 215–340. [Itinerary of travels of author and M. A. Carriker, Jr., collecting birds in southern Veracruz in 1939, 1940, and 1941. Contains a brief history of bird collecting in the area.]

WHITE, STEPHEN S. 1948. *The vegetation and flora of the region of the Río Bavispe in northeastern Sonora, Mexico.* Lloydia 11(4): 229–302. [Includes a history of natural history exploration of northeastern Sonora as well as an account of the author's travels while collecting plants there during the period 1938–1941.]

WHITTLE, TYLER. 1970. *The Plant Hunters. Being an Examination of Collecting With an Account of the Careers & Methods of a Number of Those Who Have Searched the World for Wild Plants.* Philadelphia: Chilton Book Co., 281 pp. [See chapter "From Mexico to Patagonia" for general historical information and discussion of problems encountered by early plant collectors in Latin America. The only specific reference to a collector of Mexican plants is that for Benedict Roezl.]

WIGGINS, IRA L. 1932. *Tia Juana to San José del Cabo. A botanical expedition through Lower California.* Madroño 2: 65–71. [Describes the country and its vegetation during a trip April 2–June 6, 1931, in Baja California.]

WIGGINS, IRA L. 1960. *Investigations in the natural history of Baja California.* Proc. Calif. Acad. Sci., ser. 4, 30(1): 1–45. [During 1958–1959 three major expeditions and several trips of short durations were made in Baja California under the auspices of the Belvedere Scientific Fund/California Academy of Sciences to study the natural history of the area. Several biologists were involved and collections of many kinds of organisms, especially plants, were made. This is an interesting narrative account of these travels. Illustrated with color photographs.]

WIGGINS, IRA L. 1963. *Botanical investigations in Baja California, Mexico.* Plant Sci. Bull. 9: 1–6. [Review of the botanical explorers of Baja California and the regions that they visited. Also gives personal account of collections and botanical study by the author and contemporaries in Baja California].

WIGGINS, IRA L. 1969. *Observations on the Vizcaíno Desert and its biota.* Proc. Calif. Acad. Sci., ser. 4, 36: 317–346. [Describes a collecting trip to the Vizcaíno Desert of Baja California, March 25–April 12, 1961. Includes an excellent description of the area. A list of collecting stations is appended. Also contains maps and photographs, several of which are in color.]

WIGGINS, IRA L. 1980. *Flora of Baja California.* Stanford: Stanford Univ. Press, 1025 pp. [Contains an excellent historical account of botanical exploration in Baja California, pp. 40–45.]

WILKES, H. GARRISON. 1991. *Efraím Hernández Xolocotzi-Guzmán 1913–1991.* Econ. Bot. 45: 301–302. [Biographical information on ethnobotanist, plant collector, and teacher in Mexico.]

WILLIAMS, LOUIS O. (ed.). 1963. *Homage to Standley. Papers in Honor of Paul C. Standley.* Chicago Nat. Hist. Mus., 115 pp. [This book contains a series of short accounts by different authors about Standley's life and botanical contributions. A large portion of that included refers to Standley's work in Central America, but some of his activities in Mexico are briefly mentioned. A few of his letters referring to the collections of Mexican plants of Thaddeus Haenke and of Sessé and Mociño are included. Considerable information about *Trees and Shrubs of Mexico*, one of Standley's major works, may be gleaned from the various papers in this book. Several portraits of Standley are included.]

WILLIAMSON, MICHAEL A. 1986. *Trail of the Snake from Big Bend to Baja.* Santa Fe, New Mexico: Sunstone Press, 127 pp. [Brief account of a trip to Baja California in 1980 to study and collect snakes, pp. 90–97; photographs.]

WILSON, CAROL GREEN. 1955. *Alice Eastwood's Wonderland. The Adventures of a Botanist.* San Francisco: Calif. Acad. Sci., 222 pp. [Although Eastwood apparently did not herself collect in Mexico, she did write a paper on Mexican plants (Eastwood 1929). Wilson's book contains considerable information on T. S. and Katharine Brandegee, Ynés Mexia, and especially Gustav Eisen, all of whom were involved in Mexican natural history.]

WILSON, EDWARD O. 1994. *Naturalist.* Washington, D.C.: Island Press, 380 pp. [In this biographical account the author briefly describes his entomological travels in Mexico in 1953. The description of an ascent of Pico de Orizaba to about 4,000 m in search of ants is of special intererest.]

WISLIZENUS, [FRIEDERICH] A[DOLPHE]. 1848. *Memoir of a Tour to Northern Mexico, Connected With Col. Doniphan's Expedition in 1846 and 1847.* Misc. Publ. 26, U.S. Senate, 30th Cong., 1st Sess., 141 pp. [Wislizenus presents a narrative account of his travel with a trading caravan in the state of Chihuahua.

Natural history collections were made during this trip and later when he was incarcerated as a Mexican prisoner west of the City of Chihuahua. Langman (1964) considered Wislizenus to be the first botanist to explore the Chihuahuan area in northern Mexico. A botanical appendix is provided by George Engelmann. Meterological tables with a list of camping sites are included. There is also a discussion of the geology of the area covered. This work was translated into German as *Denkschrift über eine Reise nach Nord-Mexiko*, Braunschweig, 1850, 211 pp., and was reprinted in facsimile by The Rio Grande Press, Inc., in 1969.]

WUJCIK, CAROL, AND JOE WUJCIK. 1992. *A first visit to the mud flats at El Pilar.* Cact. Succ. J. 64(5): 269–270. [Description of travel to a mud flat in the state of Coahuila in search of cacti; photographs.]

XÁNTUS, JOHN. 1976. *Travels in Southern California.* Detroit, Michigan: Wayne State Univ. Press, 212 pp. [Translated and edited from the original *Utazás Kalifornia Déli Részeiben*, Budapest, 1859, by T. Schoenman and H. B. Schoenman. Xántus describes his travels in California and Baja California in a series of letters. He made extensive collections of plants and animals in each of these places. See: Madden (1949), and Zwinger (1986) for additional extended information on Xántus.]

ZWINGER, ANN. 1983. *A Desert Country Near the Sea: A Natural History of the Cape Region of Baja California.* New York: Harper & Row, 399 pp. [An excellent introduction to the natural history of Baja California. There is some travel narrative, but mostly the contents of this book are descriptive and interpretive of the land and its inhabitants. It contains an excellent bibliography with an extensive notes section. A chronology of important events in the history of Baja California, including references to many natural history explorations, is included.]

ZWINGER, ANN. 1986. *Xantus—The Letters of John Xantus to Spencer Fullerton Baird from San Francisco and Cabo San Lucas 1859–1861.* Los Angeles: Dawson Book Shop, 422 pp. [This book consists of a series of letters Xántus wrote to Baird, mostly from Cabo San Lucas, about natural history collections made while he served in the capacity of Tidal Observer for the United States Coast Survey during the period 1859–1861. Zwinger provides biographical information on Xántus and explanatory notes for his letters. Xántus made extensive collections in many areas of natural history in the Cape Region of Baja. See: Madden (1949), and Xántus (1976) for more information.]

## ROSTER OF NATURALISTS AND NATURAL HISTORY COLLECTORS

The following is a list of selected individuals who collected and/or made natural history observations in Mexico. For names, brief biographical information, and references to additional naturalists who travelled in Mexico see: Barnhart (1965), Knobloch (1979, 1983), Lindsay (1955), and McVaugh (1972) for botanists; Abbott (1973) for malacologists; Adler (1989) for herpetologists; Gilbert (1977) and Mallis (1971) for entomologists; and Hume (1942) and Palmer et al. (1954) for ornithologists.

Abbott, Donald Putnam (1920– ) — Abbott 1973.

Abbott, J. F. — Nelson 1922.

Agassiz, Louis (1807–1873) — Lindsay 1955.

Ajofrín, Francisco de (1719–1789) — Ajofrín 1986.

Alamán, Lucas (1792–1853) — McVaugh 1972.

Alamis Flores, Glafiro J. (1944– ) — Knobloch 1979.

Alcocer F., Manuel — Escalante 1988.

Alcorn, J. R. — Selander et al. 1962.

Alexander, Annie Montague (1867–1950) — Ewan 1950; Palmer et al. 1954.

Alexander, Edward Johnston (1910– ) — Alexander 1945a, b; Barnhart 1965.

Allen, Betty Jane (1911– ) — Abbott 1973.

Allen, Letha S. (1887– ) — Abbott 1973.

Altamirano, Fernando (1850–1908) — Altamirano 1891, 1897, 1904a, b, 1905; Lorence & García 1989; McVaugh 1972.

Altig, Ronald Gail (1941– ) — Altig 1979.

Ames, Clifford Herman (1920– ) — Abbott 1973.

Anderson, Edgar (1897–1969) — McVaugh 1972.

Anderson, Edward Frederick (1932– ) — Anderson, E. F., 1958; Knobloch 1979.

Anderson, Robert S. (1957– ) — Anderson, R. S., 1992.

Anderson, Sydney — Anderson, S., 1972.

Anderson, William Russell (1942– ) — McVaugh 1972.

Andrews, Jean (1923– ) — Abbott 1973.

Andrieux, G. (1759–1833?) — Barnhart 1965; Hemsley 1887; Sousa 1979.

Anthony, Alfred Webster (1865–1939) — Anthony 1893; Brandegee 1900; Ewan 1950; Hanna & Anthony 1923; Knobloch 1983; Levin & Moran 1989; Lindsay 1955; Nelson 1922.

Anthony, H. E. — Banks 1962; Nelson 1922.

Appelius, Mario (1892–1946) — Appelius 1931.

Armstrong, Frank Blake (1863–1915) — Palmer et al. 1954; Phillips 1911.

Arnaud, Paul Henri, Jr. (1924– ) — Arnaud 1970.

Arsène — see Brouard.

Aschenborn, A. (1816–1865) — Barnhart 1965; Hemsley 1887.

Audubon, John Woodhouse (1812–1862) — Audubon 1984; Cole 1978; Ewan 1955.

Backeberg, Curt (1894–1966) — Backeberg 1930, 1951; West 1931 (cited under Backeberg 1930).

Bacon, John Dudley (1943– ) — Knobloch 1979.

Bailey, Vernon Orlando (1864–1942) — Anderson, S., 1972.

Baker, Frank Collins (1867–1942) — Abbott 1973; Baker 1895; Cole 1978; Stone 1895 (cited under Baker 1895).

Baker, Horace Burrington (1867–1942) — Abbott 1973; Ewan 1950.

Baker, Rollin Harold (1916– ) — Baker 1956.

Bales, Blenn Rife (1876–1946) — Abbott 1973.

Ball, George Eugene (1926– ) — Ball & Whitehead 1967.

Balls, Edward K. (1892–1984) — Balls 1939; Correll 1962; Hawkes 1941; Knobloch 1983.

Bancroft, Griffing (1879– ) — Bancroft 1932.

Banks, Richard Charles (1931– ) — Banks 1962; Lindsay 1966b.

Banta, Benjamin Harrison (1927– ) — Leviton & Banta 1964.

Barber, Charles Melvin (1876– ) — Ewan 1950; Knobloch 1979.

Barbour, Thomas (1884–1946) — Abbott 1973; Adler 1989; Barbour 1932; Chardón 1949.

Bárcena, Mariano de la (1842–1899) — Barnhart 1965; Knobloch 1979; McVaugh 1972.

Barclay, George W. — Barnhart 1965; Bentham 1844, 1846; Hemsley 1887; McVaugh 1972.

Barkelew, Frederick E. — Knobloch 1983; Levin & Moran 1989; Lindsay 1955; Nelson 1922.

Barkley, Fred Alexander (1908– ) — Barnhart 1965; Knobloch 1979, 1983.

Barker, Walter Eugene (1917– ) — Abbott 1973.

Barnes, Charles Reid (1858–1910) — Anonymous 1910; Knobloch 1983; McVaugh 1972.

Bartlett, Harley Harris (1886–1960) — Barnhart 1965; Bartlett, H. H., 1932; Knobloch 1979, 1983.

Bartlett, Richard D. — Bartlett, R. D., 1988.

Bartsch, Paul (1871–1960) — Abbott 1973; Barnhart 1965; Banks 1962; Nelson 1922.

Batty, Joseph H. (1846–1906) — Ewan 1950; Nelson 1922; Palmer et al. 1954.

Baxter, Edgar Martin (1903–1967) — Baxter 1930; Knobloch 1983; Lindsay 1955.

Beck, Rollo Howard (1870–1950) — Nelson 1922; Palmer et al. 1954.

Beebe, Mary Blair — Beebe 1905; Welker 1975 (cited under Beebe 1905).

Beebe, Charles William (1877–1962) — Beebe 1905, 1938, 1942; Berra 1977 (cited under Beebe 1905); Welker 1977 (cited under Beebe 1905).

Beechey, Frederick William (1796–1856) — Hemsley 1887; Knobloch 1983; McKelvey 1955; McVaugh 1972.

Behr, Hans Hermann (1881–1904) — Abbott 1973.

Belding, Lyman (1829–1917) — Belding 1887; Ewan 1955; Leviton & Banta 1964; Lindsay 1983; Nelson 1922; Palmer et al. 1954.

Beltrán, Enrique (1903– ) — Barnhart 1965; Beltrán 1951a, 1961.

Benson, Lyman David (1909–1993) — Knobloch 1979.

Bequaert, Joseph Charles (1886–1982) — Abbott 1973; Barnhart 1965; Bartlett, H. H., 1932; Bequaert 1933a, b; Bequaert & Clench 1933.

Berendt, H. — Kellogg 1932.

Berlandier, Jean Louis (1805–1851) — Abbott 1973; Alcocer 1899; Berlandier 1980; Briquet 1940; Geiser 1948; Hemsley 1887; Knobloch 1979; León 1909; McKelvey 1955; Pennell 1945.

Bernoulli, Carl Gustav (1834–1878) — Barnhart 1965; Drude 1878; Hemsley 1887; Miescher 1878.

Bertsch, Hans (1944– ) — Abbott 1973.

Beyer, Gustav (1840–1924) — Beyer 1976; Michelbacher & Ross 1942.

Bigelow, John Milton (1804–1878) — Barnhart 1965; Bartlett 1854; Dodson 1993; Ewan & Ewan 1981; Hemsley 1887; Knobloch 1979, 1983; Thomas 1969.

Bilimek, Dominik (1812–1884) — Hemsley 1887; Knobloch 1983; Papavero 1973.

Bischoff, Ferdinand — Ewan 1955; Kellogg 1932.

Bishop, Sherman Chauncey (1887–1951) — Adler 1989.

Blake, Emmet Reid (1908– ) — Carmony & Brown 1991.

Blatchley, Willis Standley (1859–1940) — Blatchley 1892; Kellogg 1932; Mallis 1971; Smith & Smith 1973.

Bohart, George E. — Michelbacher & Ross 1942.

Böhlke, James E. — Lindsay 1952.

Boke, Norman Hill (1913– ) — Boke 1962; Knobloch 1979.

Bonpland, Aimé Jacques Alexandre (1773–1858) — Botting 1973; Chardón 1949; Coats 1970; Hemsley 1887; Papavero 1971; Sarton 1943; Sprague 1924; Stafleu & Cowan 1976 (1: 275); Stearn 1968.

Botteri, Matteo (1808–1877) — Barnhart 1965; Hemsley 1887; Mearns & Mearns 1992; Sclater 1858; Seemann 1856.

Boucard, Adolphe (1839–1905) — Binford 1989; Boucard 1894; Godman 1915; Kellogg 1932; Mearns & Mearns 1992; Palmer et al. 1954; Sclater 1858; Smith & Smith 1973.

Bourgeau, Eugène (1813–1877) — Anonymous 1868; Ewan & Ewan 1981; Hemsley 1887; Knobloch 1983; McVaugh 1972; Stafleu & Cowan 1976 (1: 295).

Bowers, Frank Dana (1936– ) — Knobloch 1979.

Bradley, James Chester (1884–1975) — Abbott 1973; Gilbert 1977.

Brand, Donald D. (1915– ) — Duellman 1961; Knobloch 1979.

Brandegee, Mary Katharine Curran (1844–1920) — Bonta 1991; Ewan 1942, 1955; Knobloch 1983; Lindsay 1955; Nelson 1922; Setchell 1926; Thomas 1969; Wiggins 1980; Wilson 1955.

Brandegee, Townshend Stith (1843–1925) — Brandegee 1889, 1905; Bryant 1891b; Ewan 1942, 1950, 1955; Gould & Moran 1981; Knobloch 1983; Lindsay 1945, 1955; Moran 1952; Nelson 1922; Setchell 1926; Stafleu & Cowan 1976 (1: 303); Wiggins 1980; Wilson 1955.

Brassfield, Carl F. — Brassfield 1939.

Bravo–Hollis, Helia (1903– ) — Barnhart 1965; Castella 1959; Fitz Maurice 1990; Knobloch 1979, 1983.

Breedlove, Dennis Eugene (1939– ) — Breedlove 1981; McVaugh 1972; Rzedowski & Rzedowski 1989.

Breland, Osmond Phillip (1910–1984 ) — Christenson 1971.

Brennan, Mary Ellen (1934– ) — Abbott 1973.

Briggs, John C. — Arnaud 1970.

Brimley, Herbert Hutchinson (1861–1946) — Kellogg 1932.

Brooks, Paul (1909– ) —Brooks 1964.

Brouard, Arsène Gustave Joseph (=Arsène, Bro. Gerfroy) (1867–1938) — Barnhart 1965; Ewan 1950; Knobloch 1979, 1983; Standley 1927.

Brown, Frederick Martin (1903– ) — Ewan 1950.

Brown, Wilmot W. — Anderson, S., 1972; Banks 1962; Griscom 1934; Mearns & Mearns 1992; Nelson 1922; Smith & Smith 1973.

Bryant, Walter E. (1861–1905) — Bryant 1889, 1891b; Ewan 1955; Lindsay 1945, 1955, 1983; Michelbacher & Ross 1942; Nelson 1922; Palmer et al. 1954; Wiggins 1980.

Buller, Audley C. — Allen 1889, 1890, 1897; Escalante 1988.

Bullock, William (1775–1849?) — Alden & Ifft 1943; Bullock 1824; Evans 1993; Papavero 1971.

Burleigh, Thomas Dearborn —Baker 1956; Sutton 1951.

Burnham, John (1867–1926) — Palmer et al. 1954.

Cabot, Samuel (1815–1885) — Palmer et al. 1954.

Calvert, Philip Powell (1871–1961) — Calvert 1907; Mallis 1971.

Camp, Wendell Holmes (1904–1963) — Barnhart 1965; Camp 1937a; Knobloch 1983; Rickett 1964; Stafleu & Cowan 1976 (1: 429).

Cano, Gerónimo (1939– ) — Knobloch 1979.

Carlson, Margery Claire (1892– ) — Barnhart 1965; Carlson & Staley 1953; Knobloch 1983.

Carriker, Melbourne A., Jr. (1879–1965) — Emerson 1967; Wetmore 1943.

Carter, Annetta Mary (1907–1991) — Barnhart 1965; Ertter 1991; Gould & Moran 1981; Knobloch 1979, 1983; León de la Cruz 1992; Lindsay 1955, 1983; McVaugh 1972; Wiggins 1980.

Castella, Manuel T. — Castella 1959, 1960.

Cate, Crawford Neill (1905– ) — Abbott 1973.

Cazier, Mont Adelbert (1911– ) — Spieth 1950.

Chan, Gordon L. (1930– ) — Abbott 1973.

Chamberlain, J. C. — Michelbacher & Ross 1942.

Chambers, Kenton L. (1929– ) — Lindsay 1955.

Chaney, Henry — Abbott 1973.

Chapman, Frank Michler. (1864–1945) — Boynton 1956; Chapman 1933; Ewan 1950; Ewan & Ewan 1981; Peck 1982.

Clark, John Henry (ca. 1830–ca. 1885) — Ewan 1950; Kellogg 1932; Mearns & Mearns 1992; Smith & Smith 1973.

Clark, Josiah Huntoon (1878–1928) — Palmer et al. 1954.

Clark, Ora Melvin (1889–1952) — Knobloch 1979.

Clarke, Oscar F. — McVaugh 1972.

Cliff, Frank S. — Lindsay 1952.

Coan, Eugene Victor (1943– ) — Abbott 1973.

Cohen, Daniel M. — Lindsay 1952.

Colburn, Albert Ernest (1872–1953) — Palmer et al. 1954.

Cole, Leon Jacob (1877–1948) — Palmer et al. 1954.

Cole, W. Storrs (1902– ) — Abbott 1973.

Collie, Alexander (1793–1835) — Alden & Ifft 1943; Barnhart 1965; Ewan 1955; Hemsley 1887; Knobloch 1983.

Collins, Guy N. (1872–1938) — Barbour 1932; Bartlett 1932; Knobloch 1979, 1983; McVaugh 1972.

Condit, B. C. — Allen 1895.

Conrad, Jim — Conrad 1991.

Constance, Lincoln (1909– ) — Alden & Ifft 1943; Barnhart 1965; Lindsay 1955.

Conzatti, Cassiano (1862–1951) — Anonymous 1951; Barnhart 1965; Beltrán 1946, 1951a, b; Camp 1937b; Conzatti 1917, 1922; Inda 1961; Knobloch 1983; Maldonado-Koerdell 1951; Rzedowski 1981.

Cook, Orator Fuller (1867–1949) — Knobloch 1983.

Correll, Donovan Stewart (1908–1983) — Barnhart 1965; Correll 1948a, 1948b, 1960, 1962; Knobloch 1979, 1983; McVaugh 1972.

Couch, Darius Nash (1822–1897) — Anderson, S., 1972; Baker 1991; Conant 1968; Evans 1993; Kellogg 1932; Mearns & Mearns 1992; Smith & Smith 1973.

Coulter, Thomas (1793–1843) — Alden & Ifft 1943; Barnhart 1965; Briquet 1940; Coats 1970; Coville 1895; Ewan 1955; Hemsley 1887; McKelvey 1955; McVaugh 1943, 1972; Nelson 1983; Nelson & Probert 1994; Stafleu & Cowan 1976 (1: 559–560).

Coville, Frederick Vernon (1867–1937) — Barnhart 1965; Ewan & Ewan 1981.

Cowan, C[lark] P[aul] (1951– ) — Rzedowski & Rzedowski 1989.

Craig, Robert Theodore (1903– ) — Knobloch 1979; Mitich 1988.

Craig, T. — Michelbacher & Ross 1942.

Craveri, Federico (1815–1890) — Mearns & Mearns 1992.

Cronquist, Arthur (1919–1992) — McVaugh 1972.

Cross, William Henley (1928–1984) — McGovern et al. 1984.

Crowninshield, B. Davis (1905– ) — Abbott 1973.

Cruden, Robert William (1936– ) — Knobloch 1979.

Crum, Howard Alvin (1922– ) — Knobloch 1979.

Cutak, Ladislaus (1908–1973) — Cutak 1940; Knobloch 1979.

Dalquest, Walter Woelberg (1917– ) — Lowery & Dalquest 1951.

Dampf, Alfonso (1884–1948) — Gilbert 1977; Howard 1930; Mallis 1971.

Dawson, Elmer Yale (1918–1966) — Barnhart 1965; Dawson 1936, 1948, 1966–1968; Gates 1953–1954; Knobloch 1983; Lindsay 1955.

Dawson, William Leon (1873–1928) — Palmer et al. 1954.

Delgadillo-Moya, Claudio (1945– ) — Knobloch 1979.

Demaree, Delzie (1889–1987) — Wiggins 1980.

Denton, Melinda Fay (1944–1994) — McVaugh 1972; Knobloch 1979.

Deppe, Ferdinand (1794–1867) — Binford 1989; Ewan 1955; Hemsley 1887; Hitchcock 1919; Lichtenstein 1838; Lindemann 1884–1885; Nelson 1922; Papavero 1971; Pennell 1945; Schiede 1829–1830; Smith & Smith 1973; Stresemann 1954.

Dressler, Robert L. (1927– ) — Knobloch 1979.

Detling, LeRoy Ellsworth (1898–1967) — McVaugh 1972.

Dickerman, Robert W. — Escalante 1988.

Dickey, Donald Ryder (1887–1932) — Palmer et al. 1954.

Dietrich, Louis Edwards (1905– ) — Abbott 1973.

Diguet, Léon (1859–1926) — Bois 1926; Diguet 1895; Knobloch 1983; Lindsay 1955, 1983; McVaugh 1972; Nelson 1922; Smith & Smith 1973; Wiggins 1963, 1980.

Dixon, James Ray (1928– ) — Duellman 1961.

Dresser, H. E. — Selander et al. 1962.

Duellman, William Edward (1930– ) — Duellman 1961.

Dumbauld, Carl Mathews (1897– ) — Abbott 1973.

Dunn, Emmett Reid (1894–1956) — Adler 1989; Smith & Smith 1973.

Dugès, Alfred Auguste Delsescautz (1826–1910) — Adler 1989; Barnhart 1965; Beltrán 1951a; Duellman 1961; Howard 1930; Kellogg 1932; McVaugh 1972; Palmer et al. 1954; Smith & Smith 1969 (which see for list of additional biographies), 1973; Stafleu & Cowan 1976 (1: 692).

Dugés, Eugene — Papavero 1971.

Durrell, Gerald Malcolm (1925–1995) — Durrell 1972.

Eckfeldt, John W. (1851–1933) — McVaugh 1972.

Ehrenberg, Carl August (1801–1849) — Barnhart 1965; Hemsley 1887; Knobloch 1983; Lorence & García 1989; McVaugh 1972; Papavero 1973; Pennell 1945; Stafleu & Cowan 1976 (1: 727); Urban 1897.

Eisen, Gustav Adolphus (1847–1940) — Barnhart 1965; Eisen 1895, 1897, 1900; Ewan 1955; Leviton & Banta 1964; Lindsay 1983; McVaugh 1972; Michelbacher & Ross 1942; Nelson 1922; Setchell 1926; Wilson 1955.

Eiten, George (1923– ) — McVaugh 1972.

Elmore, Francis H. — McVaugh 1972.

Elwes, Henry John (1846–1922) — Palmer et al. 1954.

Emrick, George Monroe (?1852–1906) — McVaugh 1972.

Emerson, William Keith (1925– ) — Emerson 1958; Knobloch 1983.

Emory, William Hemsley (1811–1887) — Dodson 1993; Emory 1857–1859; Ewan 1950; Ewan & Ewan 1981; Knobloch 1979.

Enlich, Rudolph ( –1915) — Knobloch 1979.

Epling, Carl Clawson (1894–1968) — Barnhart 1965; Ewan 1950; Lindsay 1955.

Erlanson, Carl Oscar (1901– ) — McVaugh 1972.

Ernest, Isabell Seibert (1904– ) — Abbott 1973.

Ervendberg, Christian Friedrich Ludwig Cachand (1809–1863) — Barnhart 1965; Geiser 1948; Gray 1861; Hemsley 1887.

Evermann, Barton Warren (1853–1932) — Ewan 1950; Palmer et al. 1954.

Farmer, Wesley M. (1933– ) — Abbott 1973.

Faull, Joseph Horace (1870–1961) — Barnhart 1965; Knobloch 1979, 1983.

Feddema, Charles (1920– ) — McVaugh 1972.

Feinberg, Harold S. (1929– ) — Abbott 1973.

Felger, Richard S. — Levin & Moran 1989.

Ferris, Gordon Floyd (1893–1958) — Mallis 1971; Michelbacher & Ross 1942.

Ferris, Roxana Judkins (née Stinchfield) (1895–1978) — Ewan 1950; Knobloch 1979, 1983; McVaugh 1972; Michelbacher & Ross 1942.

Figg–Hoblyn, John P. — Arnaud 1970; Banks 1962; Lindsay 1952.

Fisher, George Lewis (1868–1953) — Ewan & Ewan 1981; Knobloch 1979; Lanjouw 1945.

Folsom, R. — Michelbacher & Ross 1942.

Forbes, Dyfrig McHattie — Lowery & Dalquest 1951.

Forrer, Alfonse — Escalante 1988; Kellogg 1932.

Franchesi, Francesco — Knobloch 1983; Lindsay 1955; Nelson 1922; Wiggins 1980.

Frazar, M. Abbott — Nelson 1922.

Frey, G. — Frey 1959.

Fric, A. V. — Schuetz 1970.

Fritz Maurice, W. A. — Fitz Maurice 1990.

Fryxell, Paul Arnold (1927– ) — Knobloch 1979.

Fuertes, Louis Agassiz (1874–1927) — Boynton 1956; Chapman 1933; Palmer et al. 1954; Peck 1982.

Funck, Nicolas (1819–1896) — Barnhart 1927, 1965; Hemsley 1887; Linden 1867; Papavero 1971.

Furness, Dwight R. — McVaugh 1972.

Gabb, William M. (1839–1878) — Abbott 1973; Barnhart 1965; Chardón 1949; Knobloch 1983; Lindsay 1955, 1983; Michelbacher & Ross 1942; Murray 1966; Nelson 1922; Wiggins 1963, 1980.

Gadow, Hans Friedrich (1855–1928) — Duellman 1961; Gadow 1908; McVaugh 1972; Palmer et al. 1954; Smith & Smith 1973.

Gaiser, Lulu Odell (1896–1965) — Knobloch 1983; McVaugh 1972.

Galeotti, Henri Guillaume (1814–1858) — Barnhart 1965; Bommer 1858; Hemsley 1887; Hitchcock 1919; Knobloch 1983; Lorence & García 1989; McVaugh 1952c, 1972, 1978.

Gander, Frank Forest — Barnhart 1965; Lindsay 1955; Thomas 1969.

Gates, Howard E. (1889–1957) — Dawson 1966–1968; Gates 1934, 1952, 1953, 1954; Knobloch 1983; Lindsay 1955; Tate 1969; Tegelberg 1939; Wiggins 1963, 1980.

Gaumer, George Franklin (1850–1929) — Barnhart 1965; Bartlett, H. H., 1932; Ewan & Ewan 1981; Godman 1915; Hemsley 1887; Knobloch 1983; Rzedowski & Rzedowski 1989; Smith & Smith 1973.

Gaut, Charles H. — Baker 1956.

Gay, Ed, and Betty Gay— Gay & Gay 1960–1961, 1961.

Gaylord, Horace — Nelson 1922.

Gentry, Howard Scott (1903–1993) — Anderson, S., 1972; Barnhart 1965; Correll 1960; Cunningham 1994; Gentry 1942, 1946a, 1946b; Knobloch 1979, 1983; Lindsay 1955, 1983; McVaugh 1972; Verbiscar 1993.

Germer, Dorothy Stephanie (1921– ) — Abbott 1973.

Gertsch, Willis J. (1906– ) — Spieth 1950.

Ghiesbreght, Auguste Boniface (1810–1893) — Barnhart 1927, 1965; Breedlove 1981; Hemsley 1887; Knobloch 1983; Linden 1867; Lorence & García 1989; McVaugh 1972; Papavero 1971; Pennell 1945; Rovirosa 1889; Rzedowski & Rzedowski 1989; Smith 1981.

Gifford, Edward Winslow (1887– ) — Barnhart 1965; Nelson 1922.

Gillespie, John W. — Wiggins 1950.

Gillett, John Montague (1918– ) — Knobloch 1979.

Gilley, Charles Louis (1911–1970) — Knobloch 1979; McVaugh 1972.

Glass, Charles — Glass 1992.

Godman, Frederick DuCane (1834–1919) — Adler 1989; Hemsley 1887; Palmer et al. 1954; Papavero 1973; Selander & Vaurie 1962; Smith & Smith 1973.

Gold, Dudley B. — Castella 1959; Gold & Sánchez-Mejorada 1956, 1962; Johnson & Johnson 1982; Knobloch 1983.

Goldman, Edward Alphonse (1873–1946) — Anderson, S., 1972; Baker 1956; Banks 1962; Breedlove 1981; Evans 1993; Ewan & Ewan 1981; Goldman 1916, 1951; Knobloch 1979, 1983; Lindsay 1955, 1983; Nelson 1922; Palmer et al. 1954; Rzedowski & Rzedowski 1989; Sterling 1991; Wiggins 1980.

Goldman, Luther J. — Nelson 1922.

Goldsmith, Peter Hair (1865–1926) — McVaugh 1972.

Gómez–Pompa, Arturo (1934– ) — Miranda 1961b.

González–Medrano, Francisco (1939– ) — Knobloch 1979.

González Ortega, Jesús (1876–1936) — Barnhart 1965; Bravo 1936; Escalante 1988; González 1927, 1929; Hemsley 1887; Inda 1961.

Gordon, Gary Dave (1937– ) — Abbott 1973.

Goss, Nathaniel Stickney (1826–1891) — Palmer et al. 1954.

Gould, Frank Walton (1913–1981) — Gould & Moran 1981; Knobloch 1979, 1983.

Graber, Jean Weber (1924– ) — Knobloch 1979; McVaugh 1972; Selander et al. 1962.

Graber, Richard R. — McVaugh 1972; Selander et al. 1962.

Graham, George John (1803–1878) — Barnhart 1965; Hemsley 1887.

Granite, Edwin Lionel (1933– ) — Abbott 1973.

Grant, P. R. — Escalante 1988.

Grayson, Andrew Jackson (1818–1869) — Bryant 1891a; Escalante 1988; Ewan 1955.

Greene, Edward Lee (1843–1915) — Barnhart 1965; Evans 1993; Ewan 1950; Ewan & Ewan 1981; Knobloch 1983; Lindsay 1955; Nelson 1922; Stafleu & Cowan 1976 (1: 995–996); Thomas 1969; Wiggins 1963, 1980.

Gregg, Josiah (1806–1850) — Barnhart 1965; Evans 1993; Ewan 1950; Fulton 1941–1944; Hemsley 1887; Knobloch 1979, 1983; McVaugh 1972; Mitich & Kyser 1990.

Grigsby, David — Grigsby 1983.

Griffiths, David (1867–1935) — Ewan 1950; Knobloch 1979; McVaugh 1972.

Grimm, Frank Wayne (1941– ) — Abbott 1973.

Gudnason, Kay Linsley (1912– ) — Abbott 1973.

Haenke, Thaddeus (1761–1816) — Alden & Ifft 1943; Barnhart 1965; Cavanilles 1800; Chardón 1949; Engstrand 1981; Ewan 1955; Hemsley 1887; Higueras 1989; Knobloch 1983; Kühnel 1960; McKelvey 1955; Pennell 1945; Stafleu & Cowan 1979 (2: 6–7).

Hahn, Ludwig ( –1873) — Barnhart 1965; Hemsley 1887.

Hains, Charles D. — Nelson 1922.

Hall, Eugene Raymond (1924– ) — Selander et al. 1962.

Hammerly, Betty — Lindsay 1955.

Hanna, G. Dallas (1887–1970) — Abbott 1973; Arnaud 1970; Banks 1962; Barnhart 1965; Ewan 1955; Hanna 1925, 1926; Hanna & Anthony 1923; Knobloch 1983; Michelbacher & Ross 1942; Stafleu & Cowan 1979 (2: 45–46).

Harbison, Charles Francis (1904– ) — Barnhart 1965; Knobloch 1983; Lindsay 1955.

Hardy, Cecil Ross (1908– ) — Abbott 1973.

Hardy, Robert William Hale (1794?–1871) — Hardy 1977.

Harmon, William Edward (1941– ) — Knobloch 1979.

Harris, Bessie B. (1913– ) — Abbott 1973.

Harry, L. — Escalante 1988.

Harshberger, John William (1869–1929) — McVaugh 1972.

Hartman, Carl Vilhelm (1862–1941) — Knobloch 1979, 1983.

Harvey, LeRoy Hatfield (1911– ) — Knobloch 1979.

Hartweg, Norman Edouard (1904–1964) — Duellman 1961.

Hartweg, Karl Theodor (1812–1871) — Alden & Ifft 1943; Anonymous 1846; Barnhart 1965; Breedlove 1981; Coats 1970; Ewan 1955; Hartweg 1841, 1843; Hemsley 1887; Jepson 1897; Knobloch 1983; Linden 1867; McKelvey 1955; McVaugh 1970, 1972, 1991; Pennell 1945; Rzedowski & Rzedowski 1989; Stafleu & Cowan 1979 (2: 70); Thomas 1969.

Hawkes, John Gregory (1915– ) — Knobloch 1979.

Heid, Graham — Heid 1942.

Heilprin, Angelo (1853–1907) — Barnhart 1965.

Heller, Edmund (1875–1939) — Barnhart 1965; Ewan 1950; Ewan & Ewan 1981 (list several additional references); Hemsley 1887; Nelson 1922; Smith & Smith 1973.

Henrickson, James (1940– ) — Knobloch 1979.

Hernández–Xolocotzi, Efraím Ildefonso (1913–1991) — Barnhart 1965; Knobloch 1979; McVaugh 1972; Wilkes 1991.

Hernández, Francisco (1514–1587) — Alden & Ifft 1943; Barnhart 1965; Beltrán 1961; Hemsley 1887; Miranda 1960; Somolinos d'Ardois 1951; Smith & Smith 1973; Standley 1920; Steele 1964; Stresemann 1975; Von Hagen 1944.

Herrera, Alfonso Luis (1868–1942) — Barnhart 1965; Beltrán 1951a; Howard 1930; Inda 1966.

Herrich, Clarence Luther (1858–1903) — Barnhart 1965; Escalante 1988.

Hewitt, William Paxton (1909– ) — Knobloch 1979.

Higgins, Ethel Phoebe Bailey (1866–1963) — Barnhart 1965; Knobloch 1983; Lindsay 1955.

Hinds, Richard Brinsley (1812–1847) — Alden & Ifft 1943; Barnhart 1965; Ewan 1955; Hemsley 1887; Knobloch 1983; Lindsay 1955, 1983; McKelvey 1955; McVaugh 1972; Nelson 1922; Stafleu & Cowan 1979 (2: 208); Thomas 1969; Wiggins 1963, 1980.

Hine, James Stewart (1866–1930) — Palmer et al. 1954.

Hinton, George Boole (1883–1943) — Barnhart 1965; Hinton & Rzedowski 1972, 1975; McVaugh 1972.

Hinton, Howard E. (1912– ) — Usinger 1972.

Hitchcock, Albert Spear (1865–1935) — Barnhart 1965; Ewan 1950; Ewan & Ewan 1981 (list several additional references); Hitchcock 1919; Knobloch 1979; McVaugh 1972; Stafleu & Cowan 1979 (2: 212–213).

Hitchcock, Charles Leo (1902–1986) — McVaugh 1972.

Hoag, M. E. — Hoag 1908.

Hochberg, Frederick George, Jr. (1941– ) — Abbott 1973.

Höge, C. T. — Kellogg 1932; Papavero 1973; Selander & Vaurie 1962; Smith & Smith 1973.

Holway, Edward Willet Dorland (1853–1923) — Barnhart 1965; Knobloch 1979; McVaugh 1972.

Hornaday, William Temple (1854–1937) — Cole 1978; Ewan 1950; Ewan & Ewan 1981; Hornaday 1908.

Houstoun, William (1695–1733) — Hemsley 1887; Johnston 1941; Pennell 1945; Stafleu & Cowan 1979 (2: 343); Standley 1930.

Howard, Leland Ossian (1857–1950) — Howard 1930; Mallis 1971.

Howden, Henry Fuller (1925– ) — Howden 1966.

Howell, John Thomas (1903–1994) — Barnhart 1965; Levin & Moran 1989; Lindsay 1955; McVaugh 1972; Stafleu & Cowan 1979 (2: 349).

Huey, Laurence Markham — Huey 1964; Knobloch 1983; Lindsay 1983.

Humboldt, Alexander von (1769–1859) — Beck 1959–1961; Botting 1973; Chardón 1949; Coats 1970; Hemsley 1887; Kellner 1963; Koehler 1904; Papavero 1971; Pennell 1945; Sprague 1924; Stafleu & Cowan 1979 (2: 363–366); Standley 1920; Stearn 1968; Stevens 1956; de Terra 1955.

Hunter, Joseph S. — Nelson 1922.

Iltis, Hugh Hellmut (1925– ) — Barnhart 1965; Knobloch 1979, 1983; McVaugh 1972.

Jaeger, Edmund Carroll (1877–1983) — Abbott 1973; Jaeger 1959; Knobloch 1983.

Johns, Veronica Parker (1907– ) — Abbott 1973.

Johnson, Joan — Johnson, J., 1969.

Johnson, Mabel — Johnson, M., 1961.

Johnston, Ivan Murray (1898–1960) — Barnhart 1965; Correll 1961; Ewan 1950; Johnston 1924, 1931; Knobloch 1979, 1983; Lindsay 1955; Stafleu & Cowan 1979 (2: 451); Thomas 1969; Wiggins 1963, 1980.

Johnston, Marshall Conring (1930– ) — Knobloch 1979; McVaugh 1972.

Jones, George Neville (1903–1970) — Knobloch 1979.

Jones, Marcus Eugene (1852–1934) — Barnhart 1965; Blake 1945; Broaddus 1935; DuShane 1971; Ewan 1950; Ewan & Ewan 1981; Gould & Moran 1981; Howell 1965; Jepson 1934; Jones 1935; Knobloch 1979, 1983; Lenz 1986; Lindsay 1955; McVaugh 1972; Morton 1945; Nelson 1922; Parry 1929; Rodgers 1944; Stafleu & Cowan 1979 (2: 456); Thomas 1969; Wiggins 1963.

Jones, Rodney Wilson — Jones 1943.

Jouy, Pierre Louis (1856–1894) — Kellogg 1932; Knobloch 1983; McVaugh 1972; Palmer et al. 1954.

Jürgensen, C. — Barnhart 1965; Hemsley 1887; Lorence & García 1989.

Kalm, Pehr (1716–1779) — Engstrand 1981.

Karwinski, Wilhelm Friedrich von (1780–1855) — Barnhart 1965; Hemsley 1887; Lorence & García 1989; McVaugh 1972, 1980.

Kearney, Thomas Henry, Jr. (1874–1956) — Barnhart 1965; Barbour 1932; Lindsay 1955; Knobloch 1983; Thomas 1969.

Keen, Angeline Myra (1905– ) — Abbott 1973.

Keiffer, Hartford H. — Hanna 1926; Keiffer 1925–1926; Michelbacher & Ross 1942.

Keil, David John (1946– ) — Knobloch 1979.

Kellogg, Louise — Lindsay 1955.

Kempton, James Harry (1891– ) — Barnhart 1965; Barbour 1932; Knobloch 1979, 1983; McVaugh 1972.

Kenoyer, Leslie Alva (1883–1964) — Knobloch 1979.

Kerber, Edmund — Barnhart 1965; McVaugh 1972.

Kimnach, Myron William (1922– ) — Kimnach 1964–1965; Knobloch 1979, 1983.

King, Robert Merrill (1930– ) — Knobloch 1979; McVaugh 1972.

Kino, Eusebio Francisco (ca. 1644–1711) — Abbott 1973.

Kinsey, Alfred Charles (1894–1956) — Barnhart 1965; Christenson 1971.

Kirchner, Joseph Watson (1944– ) — Abbott 1973.

Knab, Frederick (1865–1918) — Kellogg 1932; Mallis 1971.

Knobloch, Irving William (1907– ) — Knobloch 1960, 1979, 1983.

Kres, Joseph — Knobloch 1983; Kres & Kres 1960.

Krutch, Joseph Wood (1893–1970) — Knobloch 1983; Krutch 1961.

LaFollette, Patrick Ives (1945– ) — Abbott 1973.

Lamb, Chester C. — Escalante 1988.

Lamb, Frank Haines (1875–1951) — Barnhart 1965; McVaugh 1972.

Lance, James Robert (1928– ) — Abbott 1973.

Land, William Jesse Goad (1865–1942) — Barnhart 1965; McVaugh 1972.

Langlassé, Eugène ( –1900) — Barnhart 1965; Knobloch 1983; McVaugh 1951.

Langman, Ida Kaplan (1904–1991) — Butanda 1992; Knobloch 1979, 1983; Langman 1953; McVaugh 1972.

Lau, Alfred Barnhard (1928– ) — Knobloch 1979.

Lay, George Tradescant ( –1845) — Alden & Ifft 1943; Barnhart 1965; Ewan 1955; Hemsley 1887; Knobloch 1983; McVaugh 1972; Pennell 1945.

Leavenworth, William Clarence (1917–1944) — Knobloch 1979; McVaugh 1972.

Leech, Hugh Bosdin (1910– ) — Kavanaugh & Arnaud 1981; Leviton & Banta 1964.

Leibold, Friedrich Ernst (1804–1864) — Hemsley 1887.

Lemmon, John Gill (1832–1908) — Anonymous 1906b; Barnhart 1965; Ewan 1950, 1955; Knobloch 1983; McVaugh 1972; Nelson 1922; Stafleu & Cowan 1979 (2: 840–841); Thomas 1969; Wiggins 1963, 1980.

Lemmon, Sarah Allen Plummer (1836–1923) — Anonymous 1906b; Barnhart 1965; Knobloch 1983; McVaugh 1972; Stafleu & Cowan 1979 (2: 840–841).

León, Nicolás (1859–1929) — Barnhart 1965; Langman 1964.

Leopold, Aldo (1887–1948) — Carmony & Brown 1991; Meine 1988; Palmer et al. 1954.

Leopold, Aldo Starker (1913– ) — Anderson, S., 1972; Baker 1956; Knobloch 1979; Leopold 1959.

LeSueur, David Hardeman, Jr. (1909–1942) — Knobloch 1979, 1983.

Leviton, Alan Edward (1930– ) — Arnaud 1970; Banks 1962; Leviton & Banta 1964; Wiggins 1969.

Lexarza, Juan Martínez de (1785–1824) — Barnhart 1965; Hemsley 1887; Pennell 1945.

Liebmann, Frederik Michael (1813–1856) — Barnhart 1965; Hemsley 1887; Hitchcock 1919; Liebmann 1843; Lorence & García 1989; McVaugh 1972, 1987; Papavero 1973; Pennell 1954; Smith & Smith 1973; Stafleu & Cowan 1981 (3: 12–13).

Light, Frank Baugh, Jr. (1925– ) — Abbott 1973.

Lincecum, Gideon (1793–1874) — Barnhart 1965; Burkhalter 1965; Evans 1993; Geiser 1948; Kellogg 1932; Lincecum & Phillips 1994.

Lindbergh, Jon M. — Lindsay 1952.

Linden, Jean Jules (1817–1898) — Barnhart 1927, 1965; Breedlove 1981; Hemsley 1887; Linden 1867; Papavero 1971; Pennell 1945; Smith 1981; Stafleu & Cowan 1981 (3: 42); Standley 1930.

Lindsay, George Edmund (1916– ) — Arnaud 1970; Knobloch 1979; Levin & Moran 1989; Lindsay 1939, 1943, 1952, 1955, 1962a, 1962b, 1963, 1964, 1966a, 1966b; Mitich 1988–1989; Moran 1962; Sánchez-Mejorada 1958.

Llave, Pablo de la (1773–1833) — Barnhart 1965; Hemsley 1887; Knobloch 1983; Pennell 1945; Sosa 1885–1886a.

Lloyd, Robert Michael (1938– ) — Knobloch 1979.

Lloyd, William — Kellogg 1932.

Longinos Martínez, José ( –1803) — Barnhart 1965; DuShane 1971; Engstrand 1981; Knobloch 1983; Lindsay 1955, 1983; McVaugh 1977; 1983; Rickett 1947; Simpson 1938, 1940, 1961; Wiggins 1963.

Lowe, Herbert Nelson (1880–1936) — Abbott 1973.

Lowery, George Hines, Jr. — Baker 1956; Lowery & Dalquest 1951.

Lozano, Filomeno L. — Altamirano 1904b.

Lumholtz, Carl (Karl Sofus) (1851–1922) — Anderson, S., 1972; Knobloch 1979, 1983; Lumholtz 1902, 1912, 1921; McVaugh 1972.

Lundell, Cyrus Longworth (1907–1994) — Barnhart 1965; Bartlett 1932; Knobloch 1979, 1983; Lundell 1938; McVaugh 1972; Rzedowski & Rzedowski 1989.

Lunt, S. C. C. — Nelson 1922.

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McCullagh, William Henry (1938– ) — Abbott 1973.

McDougall, Walter B. — Baker 1956; Taylor et al. 1946.

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Michener, Charles D. (1918– ) — Michelbacher & Ross 1942; Spieth 1950.

Mickel, John Thomas (1934– ) — Knobloch 1983; Mickel 1965.

Miller, Frederick W. — Baker 1956.

Miller, Loye Holmes (1874–1970) — Escalante 1988; Miller 1950; Nelson 1922.

Miller, Walter Bernard (1918– ) — Abbott 1973.

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Millspaugh, Charles Frederick (1854–1923) — Barnhart 1965; Bartlett 1932; Knobloch 1983; Rzedowski & Rzedowski 1989; Standley 1930.

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Morelet, Pierre Marie Arthur (1809–1892) — Smith & Smith 1973.

Morris, Bingham W. — Michelbacher & Ross 1942.

Morrison, Joseph Paul Eldred (1906– ) — Abbott 1973.

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Müller, Frederick — Barnhart 1965; Hemsley 1887.

Muller, Cornelius Herman (1909– ) — Barnhart 1965; Knobloch 1979, 1983; McVaugh 1972.

Murrill, William Alphonso (1869–1957) — McVaugh 1972; Murrill 1910; Nishida 1989.

Nash, Thomas Hawkes, III (1945– ) — Knobloch 1979.

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Ochoterena, Isaac (1885–1950) — Knobloch 1983.

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Paray, Ladislao — McVaugh 1972; Paray 1946, 1949a, 1949b, 1951.

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Parkinson, John — Hemsley 1887.

Parry, Charles Christopher (1823–1890) — Barnhart 1965; Bartlett, J. R., 1854; Dodson 1993; DuShane 1971; Evans 1993; Ewan 1950, 1955; Hemsley 1887; Knobloch 1979, 1983; Lindsay 1955; McKelvey 1955; Nelson 1922; Orcutt 1890; Parry 1929; Rodgers 1944; Stafleu & Cowan 1983 (4: 79–80); Thomas 1969; Wiggins 1963.

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Reveal, James L. (1941– ) — Knobloch 1979.

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Rich, William — Kellogg 1932.

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Saussure, Henri Louis Frederic de (1829–1905) — Kellogg 1932; Papavero 1973.

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Shaw, George Russell (1848–1937) — Altamirano 1904b; Barnhart 1965; McVaugh 1972; Stafleu & Cowan 1985 (5: 552).

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Simard, Diane de Vry (1934– ) — Abbott 1973.

Simons, Perry Oveitt (1869–1901) — Palmer et al. 1954.

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Soulé, Michael — Lindsay 1983.

Sphon, Gale G. (1934– ) — Abbott 1973.

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Staley, Kate — Carlson & Staley 1953.

Standley, Paul C. (1884–1963) — Barnhart 1965; Ewan & Ewan 1981; Knobloch 1983; Williams 1963.

Starling, R. J. — Starling 1988.

Steere, William Campbell (1907–1989) — Barnhart 1965; Knobloch 1983; Lindsay 1952, 1955.

Steinbeck, John (1902–1968) — Carmony & Brown 1992; Hedgpeth 1978; Lindsay 1983; Steinbeck 1951; Steinbeck & Ricketts 1941.

Stephens, Frank — Nelson 1922.

Stewart, Alban — Wiggins 1980.

Stockton, Alfred L. — Brandegee 1900; Levin & Moran 1989; Nelson 1922.

Stone, Witmer (1866–1939) — Bartlett 1932.

Stowell, J. C. — Nelson 1922.

Straw, Richard Myron (1926– ) — Knobloch 1979; McVaugh 1972.

Streator, Clark Perkins (1866–1952) — Anderson, S., 1972; Baker 1956; Palmer et al. 1954.

Studley, W. B. — Michelbacher & Ross 1942.

Stretch, Richard Harper (1837–1926) — Mallis 1971.

Strother, John Lance (1941– ) — Knobloch 1979.

Streator, George Jason (1846–1925) — Abbott 1973.

Sumichrast, Adrien Louis Jean François (1828–1882) — Binford 1989; Hemsley 1887; Kellogg 1932; Knobloch 1983; Papavero 1973; Smith & Smith 1973; Wauer 1992.

Sutton, George Miksch (1898– ) — Baker 1956; Sutton 1951, 1972.

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Taylor, Walter P. — Taylor et al. 1946.

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Thurber, George (1821–1878) — Barnhart 1965; Bartlett 1854; Dodson 1993; Ewan 1950; Geiser 1948; Gray 1855; Hemsley 1887; Knobloch 1979, 1983; Rusby 1890; Stafleu & Cowan 1986 (6: 334).

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Tower, W. L. (1872– ) — Tower 1905.

Townsend, Charles Haskins (1859–1944) — Ewan 1955; Kellogg 1932; Smith & Smith 1973; Townsend 1916.

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Trelease, William (1857–1945) — Ewan 1950; Knobloch 1979; McVaugh 1972.

Turner, Billie Lee (1925– ) — Knobloch 1979; McVaugh 1972.

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Vaurie, Patricia (1909–1982) — Vaurie & Vaurie 1953.

Veatch, John Allen — Barnhart 1965; Knobloch 1983; Lindsay 1955; Nelson 1922; Wiggins 1963, 1980.

Vesey, Louis de — See Xántus, John.

Villalobos F., Alejandro — Lindsay 1966b.

Vokes, Harold Ernest (1908– ) — Abbott 1973.

Vollmer, Albert M. — Lindsay 1955.

Vosnesensky, Ilya Gavrilovich (Il'ia Gavrilovich Voznesenskii) (1816–1871) — Barnhart 1965; Ewan 1955; Knobloch 1983; Lindsay 1983; Thomas 1969; Wiggins 1980.

Walther, Edward Eric (1892–1959) — Knobloch 1983; Walther 1935–1936.

Waterfall, Umaldy Theodore (1910–1971) — Knobloch 1979, 1983; McVaugh 1972.

Wauer, Roland H. (1934– ) — Wauer 1992.

Webb, Thomas H. — Kellogg 1932; Smith & Smith 1973.

Weber, Frédéric Albert (1830–1903) — McVaugh 1972.

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Wetmore, Frank Alexander (1886–1978) — Ewan 1950; Wetmore 1940, 1943.

Wheeler, William Morton (1865–1937) — Mallis 1971.

Wheelright, Joseph Balch (1906– ) — Abbott 1973.

White, Stephen Story (1909–1979) — Knobloch 1979; White 1948.

Whitehead, Donald (1939–1990) — Ball & Whitehead 1967.

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Wilbur, Robert Lynch (1925– ) — McVaugh 1952a, 1972.

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Williamson, Michael A. — Williamson 1986.

Wilson, Edward O. (1929– ) — Wilson 1994.

Wislizenus, Friedrich Adolph (1810–1889) — Barnhart 1965; Evans 1993; Ewan 1950, 1955; Ewan & Ewan 1981; Geiser 1948; Hemsley 1887; Knobloch 1979, 1983; McKelvey 1955; Pennell 1945; Stafleu & Cowan 1988 (7: 391); Wislizenus 1848.

Wright, Charles (1811–1885) — Barnhart 1965; Bartlett 1854; Dodson 1993; Ewan 1955; Geiser 1948; Hemsley 1887; Knobloch 1983; McKelvey 1955; Mearns & Mearns 1992; Shaw 1987; Stafleu & Cowan 1988 (7: 465); Thomas 1969.

Wright, William Greenwood (ca. 1830–1912) — Barnhart 1965; Ewan 1955; McVaugh 1972.

Xántus, John (=Janos Xántus, alias Louis de Vesey) (1825–1894) — Brandegee 1890; DuShane 1971; Evans 1993; Ewan 1955; Hume 1942; Knobloch 1983; Lindsay 1955, 1983; Madden 1949; McVaugh 1972; Mearns & Mearns 1992; Michelbacher & Ross 1942; Nelson 1922; Steinbeck & Ricketts 1941; Thomas 1969; Xántus 1976; Zwinger 1986.

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Zimmerman, Roger Joseph (1941– ) — Abbott 1973.

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## ABBREVIATIONS OF SERIAL TITLES

Abh. Akad. Wiss. Berlin — Abhandlungen der Akademie der Wissenschaften, Berlin
Acta Bot. Mex. — Acta Botánica Mexicana
Acta Ci. Potos. — Acta Científica Potosina
Amer. Fern J. — American Fern Journal
Amer. Geogr. Soc. Bull., New York — American Geographical Society of New York, Bulletin
Amer. Midl. Nat. — American Midland Naturalist
Amer. Mus. Novit. — American Museum Novitates
Amer. Orchid Soc. Bull. — American Orchid Society Bulletin
Amer. Philos. Soc. Year Book — American Philosophical Society, Year Book
Amer. Potato J. — American Potato Journal
Anal. Esc. Nac. Cienc. Biol. — Anales de la Escuela Nacional de Ciencias Biológicas
Anal. Hist. Nat. — Anales de Historia Natural
Anal. Inst. Biol. Méx. — Anales del Instituto de Biología, Universidad Nacional de México
Anal. Inst. Méd. Nac. Méx. — Anales del Instituto Médico-Nacional de México
Arch. Nat. Hist. — Archives of Natural History
Asa Gray Bull. — Asa Gray Bulletin
Beiträg. Entomol., Berlin — Beiträge zur Entomologie, Berlin
Belgique Hort. — La Belgique Horticole
Bol. Dirección Estud. Biól. Méx. — Boletín de la Dirección de Estudios Biológicos, Mexico City
Bol. Inst. Bot. Univ. Guadalajara — Boletín del Instituto de Botánica, Universidad de Guadalajara
Bol. Pro-Cult. Reg. — Boletín de Pro-Cultura Regional
Bol. Soc. Bot. Méx. — Boletín de la Sociedad Botánica de México
Bol. Soc. Geogr. Estad. — Boletín de la Sociedad de Geografía y Estadística
Bol. Soc. Mex. Geogr. — Boletín de la Sociedad Mexicana de Geografía
Bot. Gaz. — Botanical Gazette, London
Bot. Jahrb. Syst. — Botanische Jahrbücher für Systematik, Pflanzengeschichte und Pflanzengeographie
Brit. Cact. Succ. J. — British Cactus and Succulent Journal
Bull. Amer. Mus. Nat. Hist. — Bulletin of the American Museum of Natural History
Bull. Entomol. Soc. Amer. — Bulletin of the Entomological Society of America
Bull. Imp. Bur. Pl. Breed. Gen. — Bulletin of the Imperial Bureau of Plant Breeding and Genetics
Bull. Mus. Comp. Zool. — Bulletin of the Museum of Comparative Zoology

Bull. Mus. Hist. Nat., Paris — Bulletin du Muséum d'Histoire Naturelle, Paris
Bull. Soc. Bot. Suisse — Bulletin de la Société Botanique Suisse (=Berichte der Schweizerischen Botanischen Gesellschaft)
Bull. Soc. Imp. Naturalistes Moscou — Bulletin de la Société Impériale de Naturalistes de Moscou
Bull. Torrey Bot. Club — Bulletin of the Torrey Botanical Club
Bull. U.S. Natl. Mus. — Bulletin of the United States National Museum
Cact. Suc. Mex. — Cactáceas y Suculentas Mexicanas
Cact. Succ. J. — Cactus and Succulent Journal (preceded by: Journal of the Cactus and Succulent Society of America)
Carnegie Inst. Wash. Year Book — Carnegie Institution of Washington Year Book
Carnegie Inst. Wash. Publ. — Publications of the Carnegie Institution of Washington
Chicago Nat. Hist. Mus. — Chicago Natural History Museum
Chihuahuan Desert Disc. — Chihuahuan Desert Discovery
Chron. Bot. — Chronica Botanica
Ciencia, Méx. — Ciencia, México
Ciencias — Ciencias – Revista de Difusión
Coleopt. Bull. — Coleopterists' Bulletin.
Contr. Inst. Inv. Zonas Desérticas, Univ. Autón. San Luis Potosí — Contribuciones del Instituto de Investigaciones de las Zonas Desérticas, Universidad Autónoma de San Luis Potosí
Contr. New York Bot. Gard. — Contributions of the New York Botanical Garden
Contr. U.S. Natl. Herb. — Contributions from the U.S. National Herbarium
Contr. U.S. Natl. Mus. — Contributions from the U.S. National Museum
Contr. Univ. Michigan Herb. — Contributions from the University of Michigan Herbarium
Contr. West. Bot. — Contributions to Western Botany
Crón. Méd. Mex. — Crónica Médica Mexicana
Desert Mag. — Desert Magazine
Econ. Bot. — Economic Botany
Entomol. Arb. Mus. G. Frey — Entomologische Arbeiten aus dem Museum Georg Frey, München
Entomol. News — Entomological News
Explorers J. — Explorers Journal
Field & Lab. — Field and Laboratory
Field Mus. Nat. Hist., Bot. Ser. — Field Museum of Natural History, Botanical Series
Fieldiana — Fieldiana: Zoology
Flora — Flora oder Allgemeine Botanische Zeitung
Gard. Chron. — Gardener's Chronicle
Georgia Hist. Quart. — Georgia Historical Quarterly
Hispanic Amer. Hist. Rev. — Hispanic American Historical Review
Hort. Praticien — Horticulteur Praticien
Impr. Gob. Esta. Oaxaca — Imprenta del Gobierno del Estado de Oaxaca
Inst. Biol. Univ. Nac. Autó. Méx. — Instituto de Biológia, Universidad Nacional Autónoma de México
J. Arnold Arbor. — Journal of the Arnold Arboreteum
J. Bot. — Journal of Botany, British and Foreign
J. New York Bot. Gard. — Journal of the New York Botanical Garden
J. New York Entomol. Soc. — Journal of the New York Entomological Society
J. Roy. Hort. Soc. — Journal of the Royal Horticultural Society, London
J. Washington Acad. Sci. — Journal of the Washington Academy of Sciences
Jahrb. Königl. Bot. Gart. Berlin — Jahrbuch des Königlichen Botanischen Gartens und des Botanischen Museums zu Berlin
Kakteen Sukk. — Kakteen und andere Sukkulenten
Kew Bull. — Kew Bulletin of Miscellaneous Information
Leafl. W. Bot. — Leaflets of Western Botany
Mem. Acad. Nac. Cienc. "Antonio Alzate" — Memorias, Academia Nacional de Ciencias "Antonio Alzate"
Mem. Soc. Cient. "Antonio Alzate" — Memorias, Sociedad Cientifica "Antonio Alzate" (=Memorias de la Academia Nacional de México "Antonio Alzate")
Mem. Amer. Acad. Arts Sci. — Memoirs of the American Academy of Arts and Sciences
Méx. Antiguo — El México Antiguo
Möller's Deutsche Gärtn.-Zeitung — Möller's Deutsche Gärtner-Zeitung
Monatsschr. Kakteenk. — Monatsschrift für Kakteenkunde

Nat. Hist. — Natural History
Natl. Acad. Sci. — National Academy of Science
Natl. Geogr. Mag. — National Geographic Magazine
Occ. Pap. Calif. Acad. Sci. — Occasional Papers of the California Academy of Sciences
Ornith. Monog. — Ornithological Monographs, American Ornithological Union
Pacific Disc. — Pacific Discovery
Pan. Amer. Mag. — Pan American Magazine
Petermanns Geogr. Mitt. — Petermanns Geographische Mitteilungen
Phytologia, Mem. — Phytologia, Memoirs
Plant Sci. Bull. — Plant Science Bulletin
Proc. Amer. Acad. Arts Sci. — Proceedings of the American Academy of Arts and Sciences
Proc. Calif. Acad. Sci. — Proceedings of the California Academy of Sciences
Proc. Pacific Coast Entomol. Soc. — Proceedings of the Pacific Coast Entomological Society
Proc. U.S. Natl. Mus. — Proceedings of the United States National Museum
Proc. Zool. Soc. London — Proceedings of the Zoological Society of London
Rev. Hort. — Revue Horticole
Rev. Soc. Mex. Hist. Nat. — Revista de la Sociedad Mexicana de Historia Natural
Mem. San Diego Soc. Nat. Hist. — Memoirs of the San Diego Society of Natural History
Trans. San Diego Soc. Nat. Hist. — Transactions of the San Diego Society of Natural History
Sci. Monthly — Scientific Monthly
Smithsonian Misc. Coll. — Smithsonian Miscellaneous Collections
Soc. Bibl. Nat. Hist., Sp. Publ. — Society for the Bibliography of Natural History, Special Publication
Syst. Bot. Monogr. — Systematic Botany Monographs
Texas Geogr. Mag. — Texas Geographic Magazine
Trans. Roy. Hort. Soc. London — Transactions of the Royal Horticultural Society, London
Trans. Texas Acad. Sci. — Transactions of the Texas Academy of Science
U.S.D.A. Circ. — United States Department of Agriculture Circular
Univ. Autó. Nayarit — Universidad Autónoma de Nayarit
Univ. Calif. Publ. Bot. — University of California Publications in Botany
Univ. Kansas Publ. Mus. Nat. Hist. — University of Kansas Publications of the Museum of Natural History
Verh. Ges. Erdk. Berlin — Verhandlungen der Gesellschaft für Erdkunde zu Berlin
Verh. Naturf. Ges. Basel — Verhandlungen der Naturforschenden Gesellschaft in Basel
Vidensk. Medd. Dansk Natur. For. — Videnskabelige Meddelelser fra Dansk Naturhistorik Forening i Kjøbenhavn
West Amer. Sci. — West American Scientist
Wilson Bull. — Wilson Bulletin

Contr. Univ. Michigan Herb. 20: 129–140. 1995.

# MISCELLANEOUS NOTES ON THE GENUS SPHAGNUM. 6

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This paper includes descriptions and illustrations of eight new species of *Sphagnum*, one from the United States and eight from South America. The *Sphagna* of South America are surprisingly numerous, and as I continue to add new species, particularly from Brazil, I hope that many old ones and not too many new ones will fall into synonymy!

**Sphagnum** [sect. *Sphagnum*] **cundinamarcanum** Crum, sp. nov. Fig. 1.

Plantae aliquanto robustae, pallido-luteae. Caules fusci; parietes externi cellularum superficialium epidermidis stratis 3–4; cellulae epidermidis efibrillosae, 1–2-porosae. Folia caulina 1.7–1.9 mm longa, lingulata, margine fibrillosa; cellulae hyalinae non septatae, superficie exteriore poris 11–14 ellipticis commissuralibus et terminalibus, apice cucullato lacunis membranaceis magnis instructae, interiore poris nullis. Fasciculi ramorum ramis 3 (2 patentibus); cellulae epidermidis fibrillosae, 1-porosae. Folia ramulina 1.8–2 mm longa, concava, ovalia, marginibus sulco resorptorio; cellulae hyalinae superficie exteriore 5–7 poris ad commissuras dispositis et ternis in angulis cellularum conjunctis, ad margines foliorum poris numerosis (10–14) ad commissuras, interiore superficie poris nullis; cellulae chlorophylliferae sectione transversali utrinque inclusae.

Plants fairly robust, 8–10 cm high, pale yellowish. Stems brown; cortex 3–4-layered, the epidermal cells elongate, efibrillose, 1–2-porose. Stem leaves 1.7–1.9 mm long, lingulate, cucullate, fringed at margins; hyaline cells fibrillose in the upper 1/2 or more, not divided, on the outer surface with 11–14 rounded, thin-margined pores at commissures and angles, with membrane gaps at the cucullate apex, on the inner surface without pores. Branches in fascicles of 3 (2 spreading); cortex fibrillose, 1-porose. Branch leaves 1.8–2 mm long, broadly oval, deeply concave, bordered by a resorption furrow; hyaline cells on the outer surface with membrane gaps at the leaf apex and relatively small, elliptic pores in 3's at adjacent angles in addition to 3–4 at the commissures and at the margins with more numerous commissural pores (10–14), on the inner surface without pores; green cells in section central and included, the hyaline cells somewhat convex on both surfaces.

Colombia. Cundinamarca: Mpio. Aquitania, Páramo Cintas, carretera Aquitania–Pajarito, 3300 m, en pared de tierra expuesto, *Margarita Escobar Acosta & José Santa 537*, 29 July 1985 (type, NY).

Striking features include the stem leaves with fringed margins but otherwise approaching branch leaves in having cucullate tips perforated by membrane gaps and numerous rounded commissural pores on the outer surface. The upper median hyaline cells of branch leaves have a few elliptic pores at commissures as well as triple pores at adjoining corners, while the marginal cells show as many as 14 commissural pores per cell.

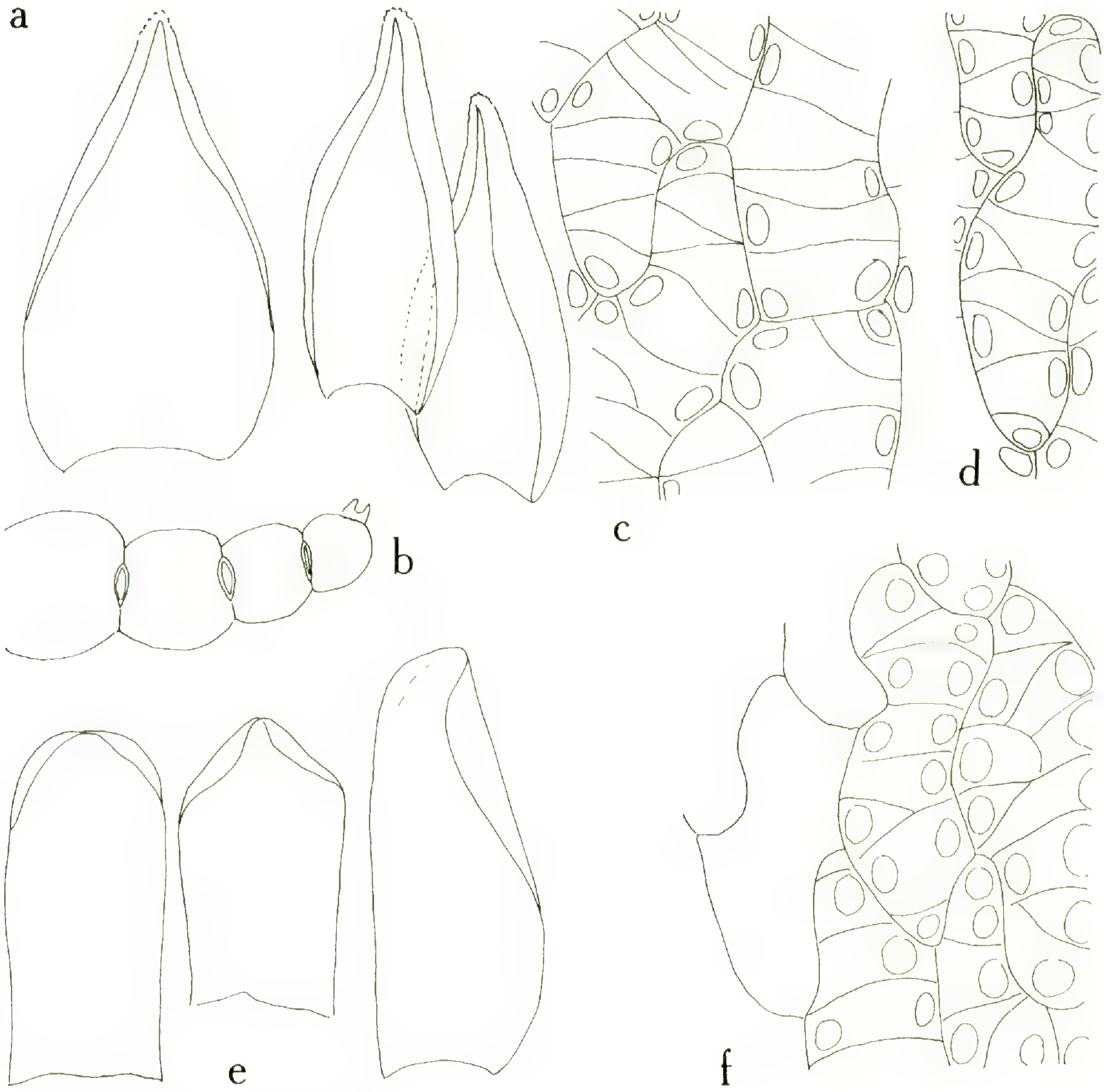



FIG. 1. *Sphagnum cundinamarcanum*. a. Branch leaves, ×25. b. Portion of branch leaf in section, ×400. c. Upper median cells of branch leaf, outer surface, ×400. d. Upper marginal cells of branch leaf, outer surface, ×400. e. Stem leaves, ×25. f. Upper cells of stem leaf, outer surface, ×400.

**Sphagnum** [sect. *Sphagnum*] **frahmii** Crum, sp. nov. Fig. 2.

Plantae usque ad 12 cm altae, pallide virides vel fuscae. Hyalodermis caulis 4 stratis; cellulae epidermidis efibrillosae vel raro imperfecte fibrillosae; cylindrus lignosus obscure fusco-rubens vel niger. Folia caulina fusca, 1.1–1.3 mm longa, lingulata, apice rotundata, ± plana; cellulae hyalinae non septatae, efibrillosae, supra medium foliorum utrinque plerumque resorptae. Rami 4-fasciculati; cellulae epidermidis efibrillosae vel infirme fibrillosae. Folia ramulina 1.8–2 mm longa, valde concava, apice cucullata, late ovata, marginibus sulco resorptorio instructis; cellulae hyalinae superficie exteriore poris ellipticis ternis in angulis conjunctis, interiore poris nullis; cellulae chlorophylliferae sectione transversali utrinque inclusae.

Plants up to 12 cm high, pale green to pale brown. Cortical cells of stem in 4 layers, 1(–2)-porose, efibrillose or occasional cells fibrillose; wood cylinder very dark red-brown, almost black. Stem leaves brown, 1.1–1.3 mm long, lingulate, rounded at the apex, plane or nearly so; hyaline cells not divided or fibrillose, largely resorbed on 1 or both surfaces in the upper half. Branches in fascicles of 4

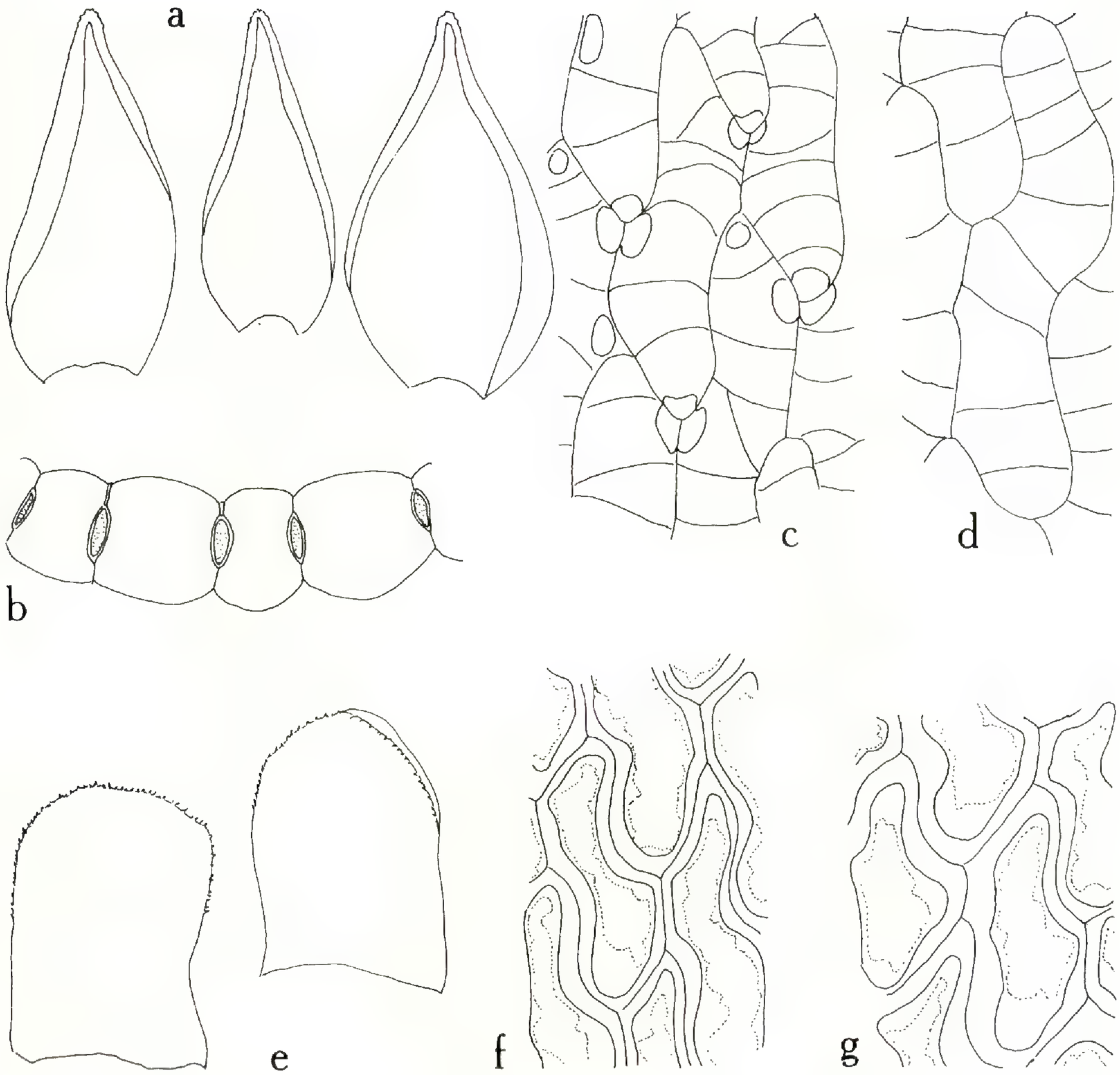



FIG. 2. *Sphagnum frahmii*. a. Branch leaves, ×25. b. Portion of branch leaf in section, ×400. c. Upper cells of branch leaf, outer surface, ×400. d. Upper cells of branch leaf, inner surface, ×400. e. Stem leaves, ×25. f. Upper cells of stem leaf, outer surface, ×400. g. Upper cells of stem leaf, inner surface, ×400.

(2 spreading); cortex efibrillose or some cells fibrillose. Branch leaves 1.8–2 mm long, deeply concave, broadly ovate, roughened at back of the apex and denticulate-bordered by a resorption furrow; hyaline cells on the outer surface with elliptic pores in 3's at adjacent angles, on the inner surface without pores; green cells in section central and entirely included or sometimes very narrowly exposed on the inner surface because of slightly thickened end walls, the hyaline cells somewhat convex on both surfaces, often somewhat more convex on the outer surface.

BRAZIL. São Paulo: an der Küstenstrasse SP55 zwischen Peruibe und Itahaem, feuchter Restingawald und anschliessende offene Sandflächen, ca. 5 m.s.m., *J.-P. Frahm 1866*, *1869*, *1874* (type), 17 July 1977 (MICH, ALTA); Regenwaldhänge nordöstlich von Dantos an der Strasse nach Bertioga, ca. 40–60 m.s.m., *Frahm 1872*, *1873*, *1875*, 18 July 1977 (MICH, ALTA).

This species somewhat resembles *S. magellanicum* Brid., particularly in sectional views of branch leaves, but it differs from that species in its occurrence at very low altitudes, brown coloration, essential absence of fibrils in the cortical cells of stems and branches, and efibrillose hyaline cells of stem leaves. The branch

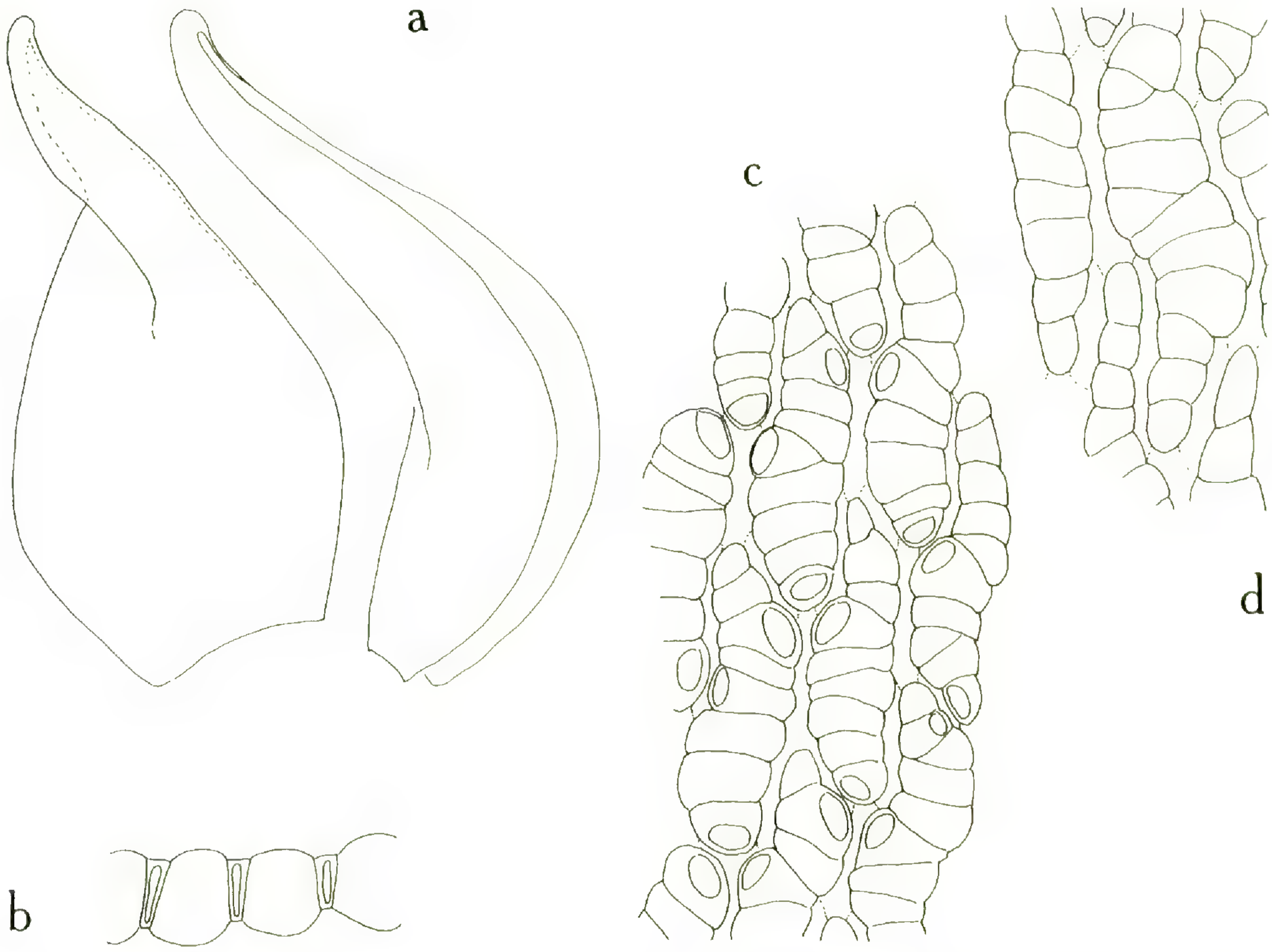



FIG. 3. *Sphagnum reclinatum*. a. Branch leaves, ×25. b. Portion of branch leaf in section, ×400. c. Upper cells of branch leaf, outer surface, ×400. d. Upper cells of branch leaf, inner surface, ×400.

leaves have, for the most part, green cells central and entirely included, as in *S. magellanicum*, but some cells are very narrowly exposed on the inner surface.

**Sphagnum** [sect. *Sphagnum*] **reclinatum** Crum, sp. nov. Figs. 3, 4.

Plantae parvae (usque ad 4 cm altae), pallide virides. Caulis prostratus vel ascendens, irregulariter ramosus. Hyalodermis caulina 2 stratis, efibrillosa, raro 1-porosa; cylindrus lignosus luteo-fuscus. Folia caulina et ramulina similes. Folia caulina 2.5–3 mm longa, elongato-ovata, concava, apice cucullata, parte superiore late patentes, marginibus sulco resorptorio instructis; cellulae hyalinae utroque plerumque fibrillosae, superficie exteriore poris ternis in angulis conjunctis, interiore nullis vel paucis; cellulae chlorophylliferae trapezoideae, utrinque superficie folii liberae, pariete exteriore saepe ± longiore.

Plants small (up to 4 cm long), pale green. Stems prostrate or ascending, irregularly branched, mostly on one side; cortical cells in 2 layers, efibrillose, rarely 1-porose; wood cylinder yellow-brown. Stem and branch leaves similar. Stem leaves 2.5–3 mm long, long-ovate, cucullate at the apex, concave, clasping at the base and wide-spreading to squarrose above whether wet or dry, bordered by a resorption furrow; hyaline cells fibrillose on both surfaces throughout, on the outer surface with elliptic pores commonly in 3's at adjacent angles, on the inner surface with pores none or very few; green cells trapezoidal, exposed somewhat more broadly on the inner surface, the hyaline cells somewhat convex on the inner surface, more broadly so on the outer. Branches single, often forked at the tip; cortex efibrillose and not or rarely uniporose. Branch leaves somewhat smaller (up to 2 mm long).

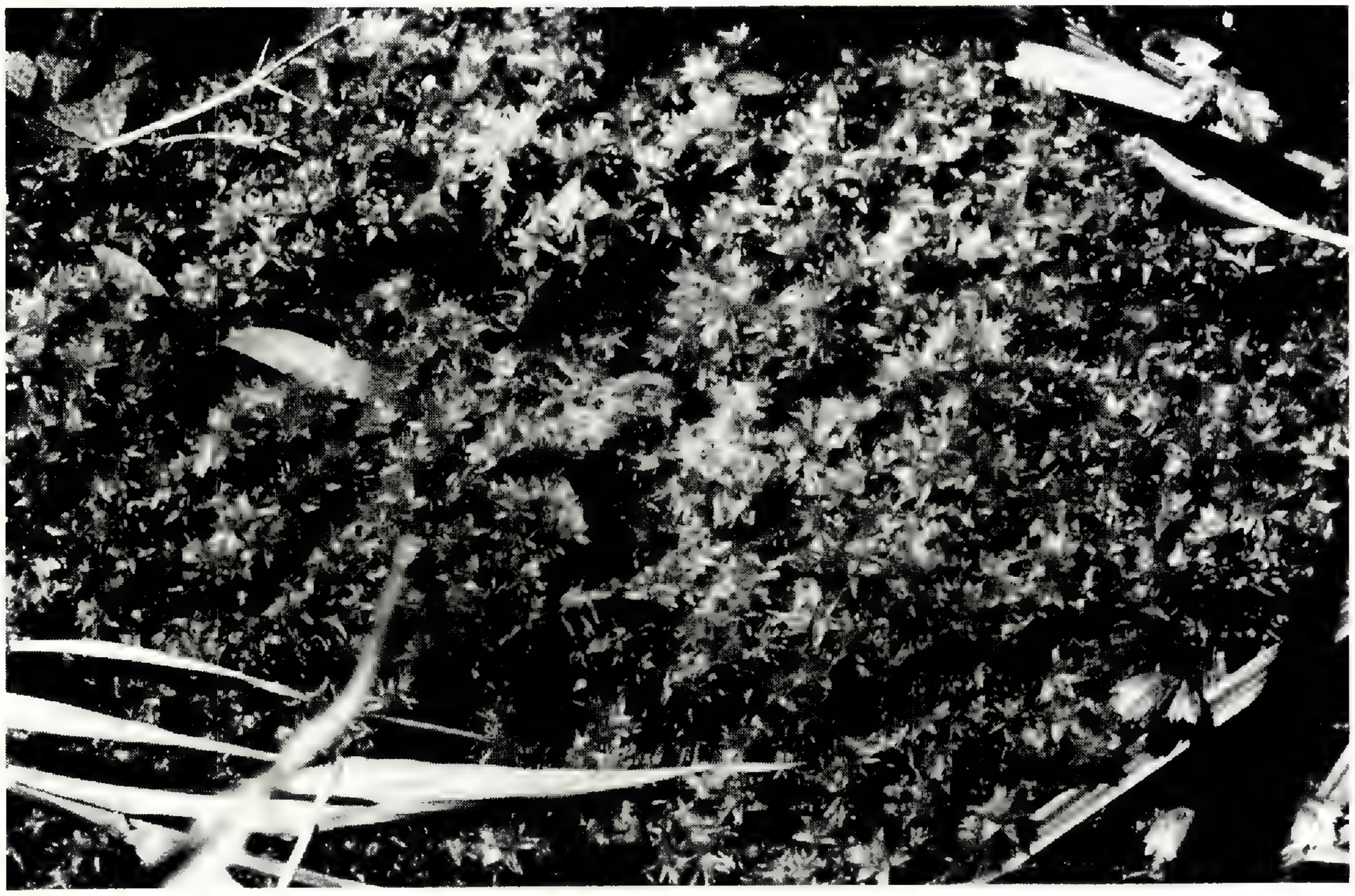


FIG. 4. *Sphagnum reclinatum*. Photograph by Wm. R. Buck.

VENEZUELA. Amazonas: Dpto. Río Negro, just outside Cañón Grande, along trail ca. 1.5–2 hours walk S of Neblina base camp to Río Agua Blanca, ca. 0°50'N, 66°10'W, low primary forest on white sand along white water river, *William R. Buck 12751,* February 1985 (MICH, holotype; NY, isotype).

Interesting characters of this species include the small size, prostrate growth, single branches produced only on the upper side of the stem, and stem and branch leaves clasping at base and wide-spreading at the tip and similar in shape and structure.

**Sphagnum** [sect. *Cuspidata*] **boyacanum** Crum, sp. nov. Fig. 5.

Plantae parvae, pallide fusco-luteae. Caulis pallidus; parietes externi cellularum superficialium epidermidis stratis duobus; cylindrus lignosus pallido-luteus. Folia caulina 1.7–1.8 mm longa, triangula, rotundo-obtusa, 3–4 seriebus cellularum limbata; cellulae hyalinae superne fibrillosae, superne raro septatae, medio usque ad basin foliorum saepe 1-septatae, superficie exteriore apice poris parvis, interiore poris nullis vel paucis in extremis cellularum. Fasciculi ramorum ramis 4 (2 patentibus). Folia ramulina ± secunda, in siccitate margine non undulata, 2–2.2 mm longa, oblongo-lanceolata, integra; cellulae hyalinae superficie exteriore poris 2–9 minutis, interiore poris nullis vel paucis, minutis; cellulae chlorophylliferae sectione transversali anguste triangulae, dorso liberae.

Plants small, pale yellow, brownish tinged above. Stems pale; cortex 2-layered; wood cylinder pale yellowish. Stem leaves 1.7–1.8 mm long, broadly oblong-triangular, rounded or rounded-obtuse at apex, bordered by 3–4 rows of linear cells; hyaline cells fibrillose in the upper half or more, occasionally 1-divided above, more commonly divided toward the leaf middle and in the lower half, on the outer surface with small apical pores, on the inner surface with pores none or with very small end pores. Branches in fascicles of 4 (2 spreading), short, curved,

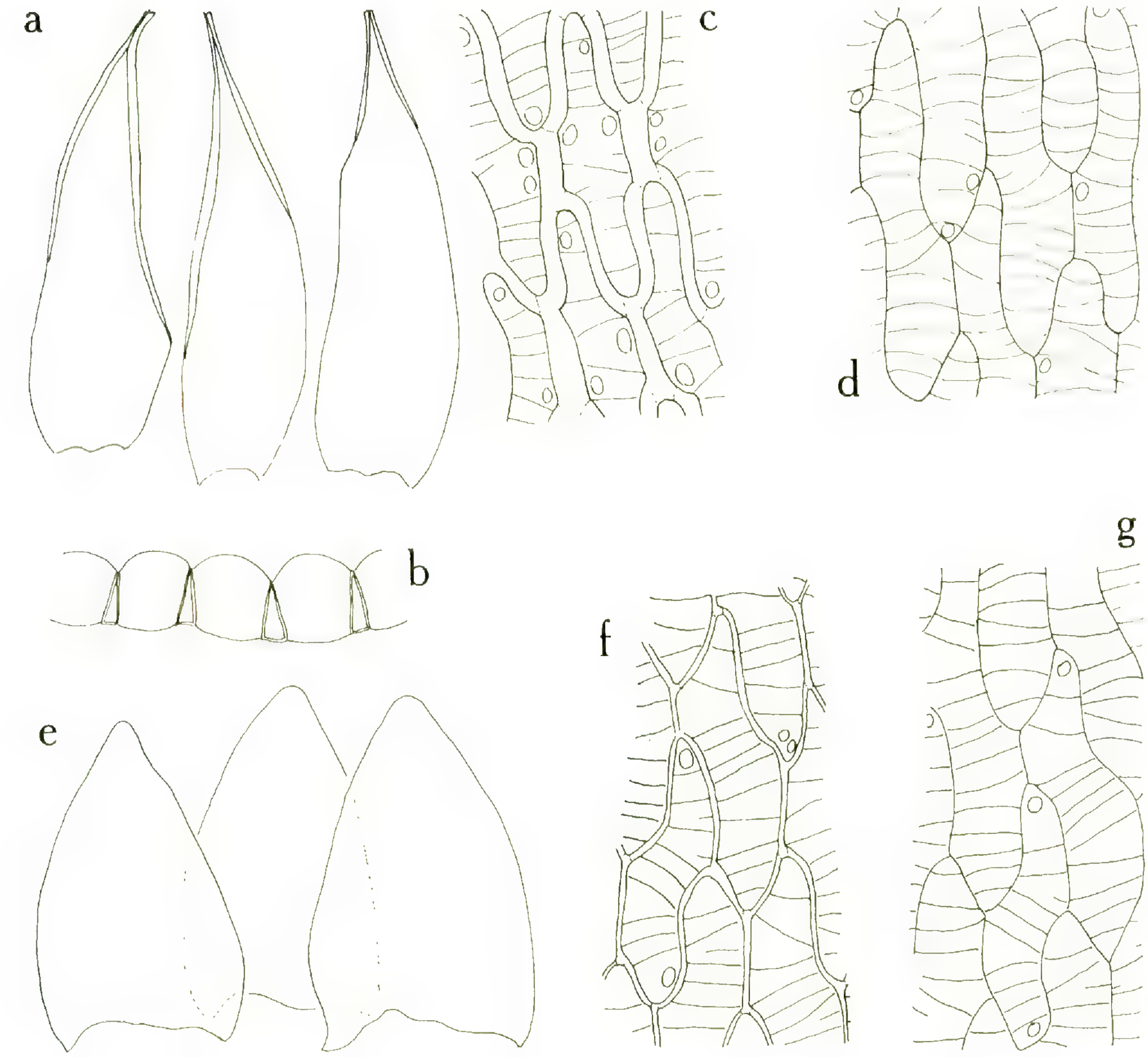
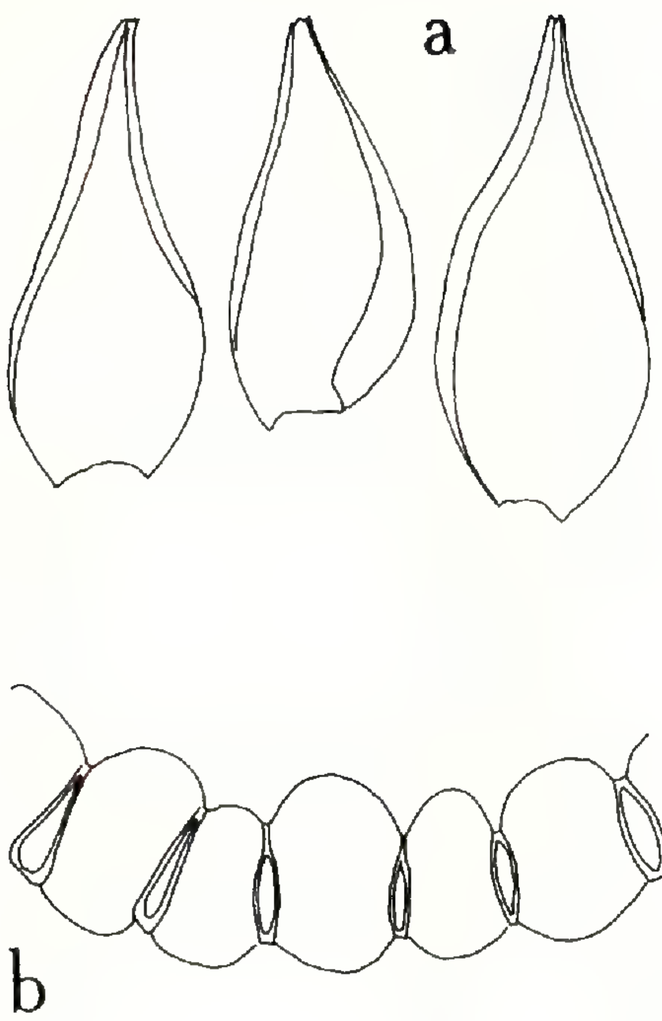



FIG. 5. *Sphagnum boyacanum*. a. Branch leaves, ×25. b. Portion of branch leaf in section, ×400. c. Upper cells of branch leaf, outer surface, ×400. d. Upper cells of branch leaf, inner surface, ×400. e. Stem leaves, ×25. f. Upper cells of stem leaf, outer surface, ×400. g. Upper cells of stem leaf, inner surface, ×400.

not particularly tapered. Branch leaves subfalcate-secund, not undulate-margined when dry, 2–2.2 mm long, oblong-lanceolate, entire; hyaline cells on the outer surface with 2–9 very small pores at ends, side corners, and commissures, on the inner surface with pores none or few, very small, in ends and side corners; green cells isosceles-triangular, exposed on the outer surface, the hyaline cells plane on the outer surface, moderately convex on the inner.

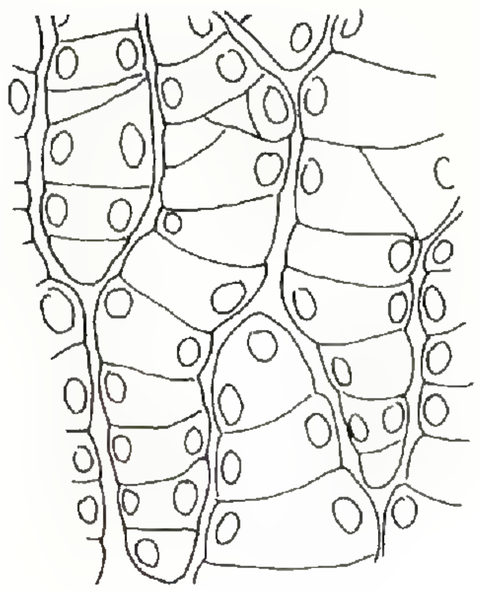
COLOMBIA. Boyaca: Dpto. Boyaca, Mpio. Chita, carretera Chita–Socha antes de llegar al Cardón, 3400 m, en el suelo pantanoso, *Margarita Escobar A. & José Santos 497*, 28 July 1985 (type, NY).

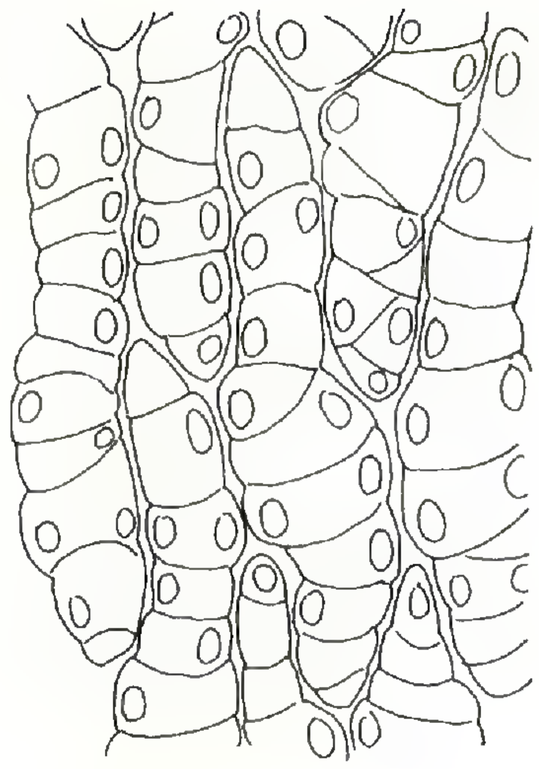
The plants have the weak appearance of *S. cuspidatum* Hoffm. and would seem to have been seasonally submerged. The curved branches and secund leaves have hyaline cells with few to numerous, very small pores at ends, side corners, and commissures on their outer surfaces. Some of the stems have slender, flexuose shoots with small, green, greatly crisped leaves. Odd as they seem, I can only assume that they are an anomaly resulting from continued growth, perhaps in a plastic bag, before drying.

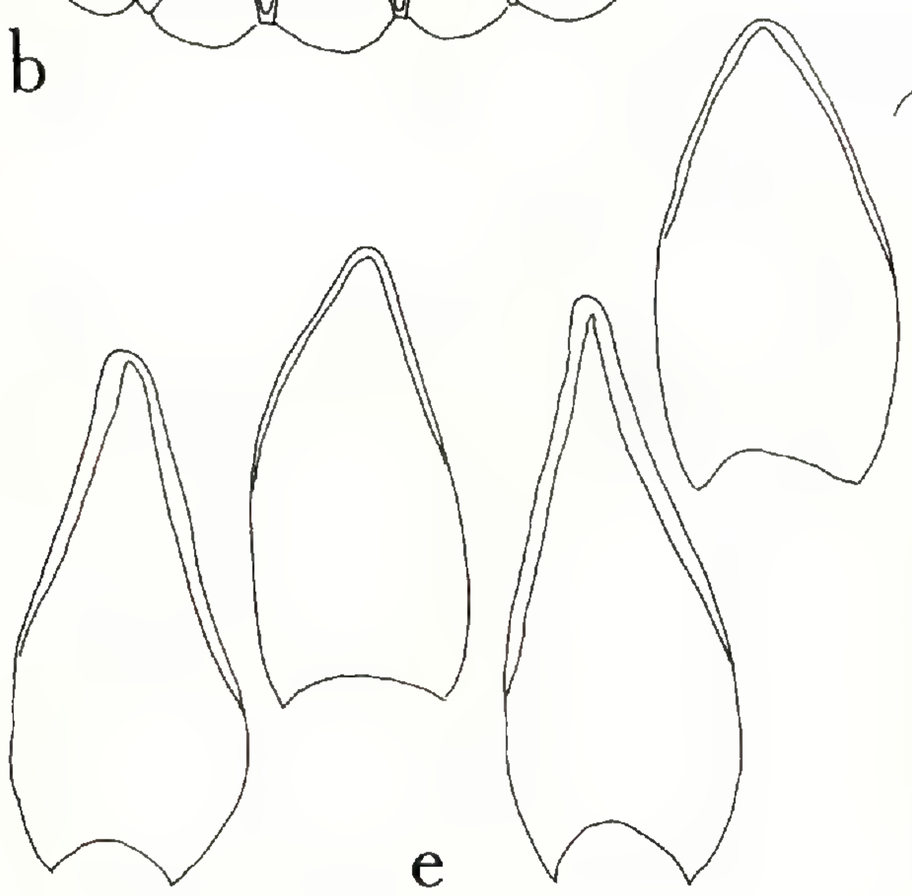


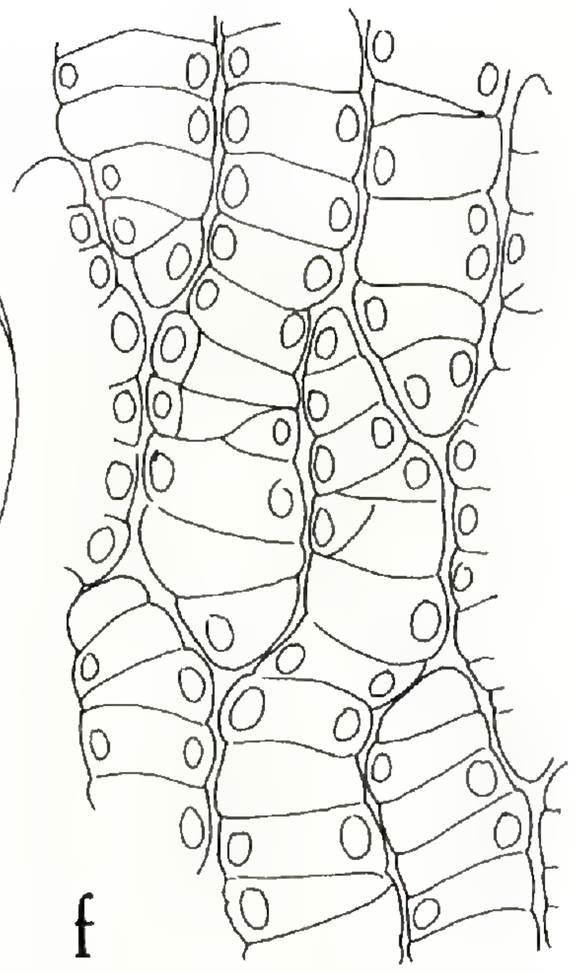






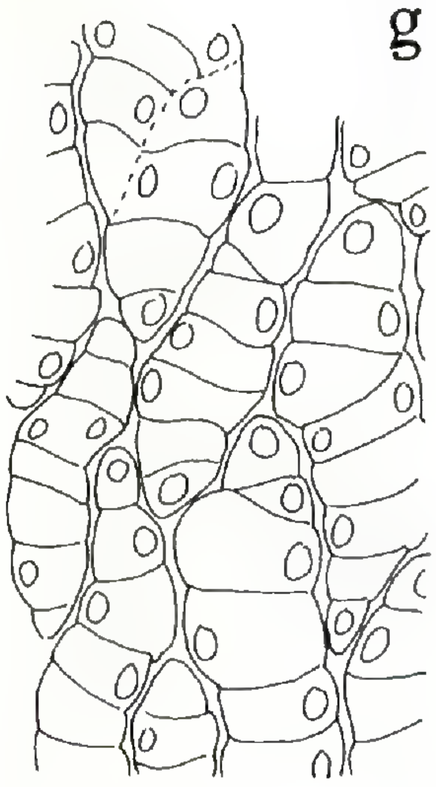




FIG. 6. *Sphagnum exile*. a. Branch leaves, ×25. b. Portion of branch leaf in section, ×400. c. Upper cells of branch leaf, outer surface, ×400. d. Upper cells of branch leaf, inner surface, ×400. e. Stem leaves, ×25. f. Upper cells of stem leaf, outer surface, ×400. g. Upper cells of stem leaf, inner surface, ×400.

**Sphagnum** [sect. *Subsecunda*] **exile** Crum, sp. nov. Fig. 6.

Plantae parvae, usque ad 4 cm altae, pallide virides. Hyalodermis caulina uno strato; cylindrus lignosus pallide luteus. Folia caulina 1.2–1.4 mm longa, concava, oblonga vel oblongo-ovata, anguste limbata; cellulae hyalinae raro septatae, plerumque fibrillosae, utrinque poris numerosis, commissuralibus, superficie exteriore saepe in seriebus ± continuis sitis. Rami singuli, breves (3–6 mm longi). Folia ramulina 1.1–1.4 mm longa, ovata; cellulae hyalinae utrinque poris commissuralibus numerosis, supra medium foliorum seriebus ± continuis; cellulae chlorophylliferae sectione transversali triangulo-trapezoideae vel orciformes, utrinque liberae, pariete exteriore saepe longiore.

Plants small, 3–4 cm high, pale green. Stem cortex in 1 layer; wood cylinder yellowish. Stem leaves 1.2–1.4 mm long, concave, oblong or oblong-ovate, narrowly bordered; hyaline cells not or very rarely divided, fibrillose throughout, with numerous pores on both surfaces, often in nearly continuous rows on the outer. Branches single, short, 3–6 mm long, terete. Branch leaves 1.1–1.4 mm long, concave, ovate; hyaline cells with numerous pores on both surfaces, in ±

continuous commissural rows in the upper 1/4 or more; green cells in section triangular-trapezoidal, narrowly exposed on the inner surface, more broadly exposed on the outer, sometimes ± orciform and equally exposed on both surfaces.

BRAZIL. Minas Gerais: Km 58 an der Strasse BR-135 zwischen Jusselino Kubitschek und Diamantina, Serra do Espinaço, 1100 m, *J.-P. Frahm 1841,* 29 July 1977 (holotype MICH; isotype, ALTA).

The species is nicely characterized by its small stature and short, terete, single branches, as well as similar stem and branch leaves with pores numerous on both surfaces and often in continuous commissural rows toward the leaf tips.

**Sphagnum** [sect. *Subsecunda*] **laxulum** Crum, sp. nov. Fig. 7.

Plantae molles, pallidae fuscae, usque ad 9 cm altae. Caulis pallidus, gracilis; hyalodermis strato uno. Caules et rami laxe foliati, apice in fasciculum dense aggregati. Folia caulina 3 mm longa, ± concava, lingulata, apice rotundata, plerumque anguste limbata; cellulae hyalinae raro 1-septatae, prope ad basin fibrillosae, superficie exteriore poris parvis, in seriebus continuis commissuralibus, interiore poris 1–3 ad angulas et commissuras dispositis. Rami singuli, 15–30 mm longi, laxe dispositi. Folia ramulina 1–2.5 mm longa, concava, late oblongo-ovata; cellulae hyalinae poris ut in foliis caulium; cellulae chlorophylliferae sectione transversali fusiformes, utrinque anguste liberae.

Plants soft, pale brownish, up to 9 cm long. Stems pale, very slender; cortical cells in 1 layer, not porose; wood cylinder brown. Stems and branches loosely foliate, ending in a globose cluster of crowded leaves; capitulum scarcely evident; branches well spaced. Stem and branch leaves similar except in size and concavity. Stem leaves 3 mm long, somewhat concave, lingulate, rounded at the apex, narrowly bordered throughout; hyaline cells not divided (or rarely 1-septate), fibrillose nearly to the leaf base, on the outer surface with many small, rounded-elliptic pores in continuous commissural rows, on the inner surface with 1–3 small pseudopores at angles and commissures. Branches single, 15–30 mm long; retort cells long and narrow, with pores scarcely protruding. Branch leaves 1–2.5 mm long, deeply concave, broadly oblong-ovate; hyaline cells undivided (or rarely 1-septate), on the outer surface with small, rounded-elliptic pores in continuous commissural rows, on the inner surface with 0–2 small pseudopores at angles and commissures; green cells in section narrowly fusiform, somewhat exposed on both surfaces owing to thickened walls, the hyaline cells slightly convex or nearly plane on both surfaces.

BRAZIL. Minas Gerais: an der Strasse MG-55 zwischen Morro do Pilar und São Sebastião, Ufer des Rio Peixe, 650 m, *J.-P. Frahm 1865*, 31 July, 1977 (holotype, MICH; isotype, ALTA).

The plants, with very slender stems and single, well-spaced and loosely foliate branches, give suggestion of an aquatic or perhaps seasonally inundated growth. The hyaline cells of both stems and branches have an abundance of pores on the outer surface and only a few pseudopores on the inner. The retort cells of the branch cortex are very long and narrow.

**Sphagnum** [sect. *Acutifolia*] **laxirameum** Crum, sp. nov. Fig. 8.

Plantae graciles sed elongatae, usque ad 16 cm altae, pallide virides. Caules pallidi; cellulae epidermidis elongatae, pro parte porosae; cylindrus lignosus ± luteus. Folia caulina 2–2.3 mm longa, concava, ovata vel oblongo-ovata, usque ad basin anguste limbata; cellulae hyalinae superne fibrillosae, superficie exteri-

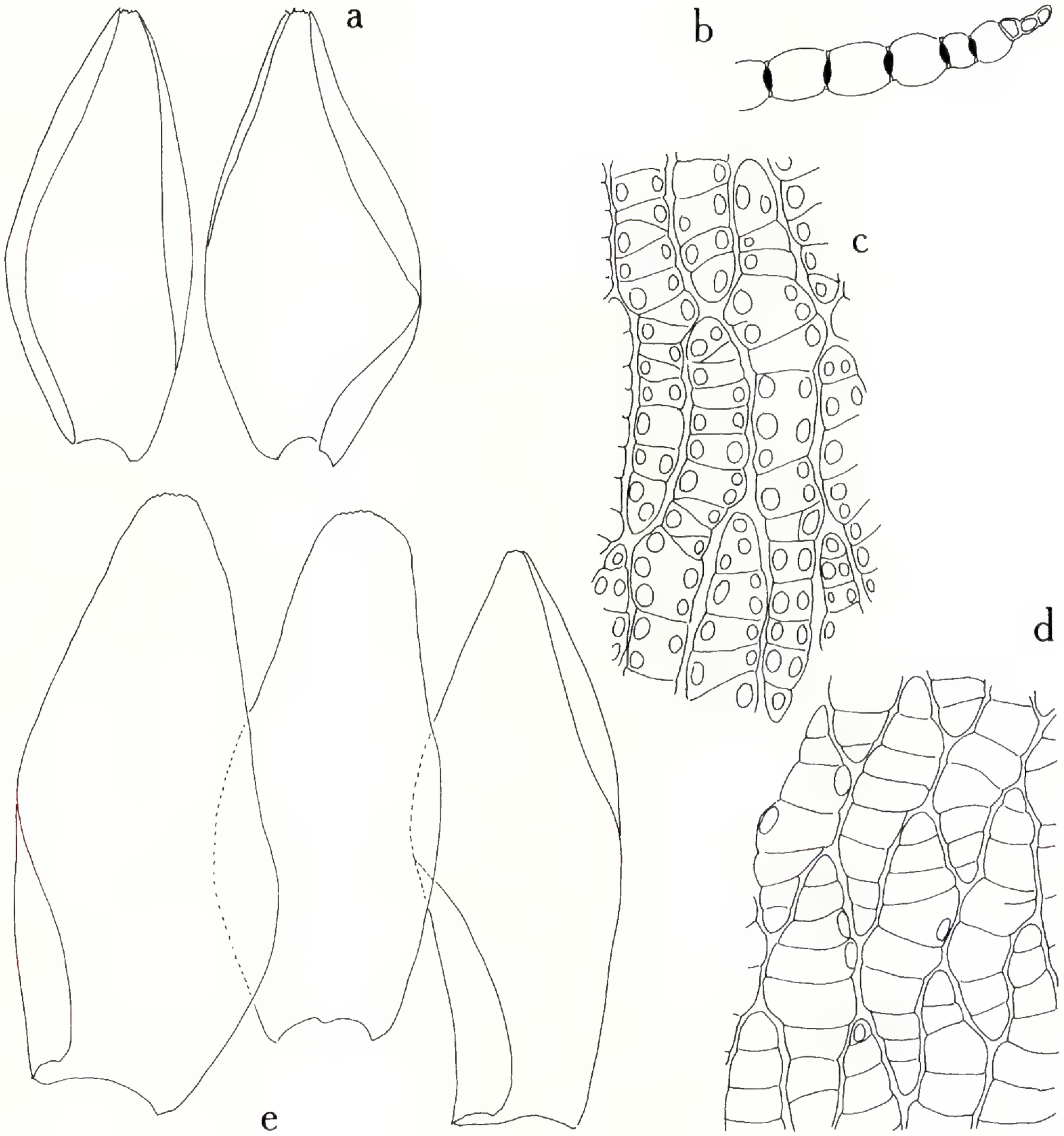



FIG. 7. *Sphagnum laxulum*. a. Branch leaves, ×25. b. Portion of branch leaf, in section, ×400. c. Upper cells of branch leaf, outer surface, ×400. d. Upper cells of branch leaf, inner surface, ×400. e. Stem leaves, ×25.

ore poris 1–5 ad angulas et commissuras dispositis, interiore omnino 1–2 lacunis rotundis. Rami 3-fasciculati. Folia ramulina 1.8–2 mm longa, concava, oblongo-ovata, anguste limbata; cellulae hyalinae superficie exteriore poris numerosis commissuralibus, interiore nullis vel paucis; cellulae chlorophylliferae sectione transversali late triangulares, superficie interiore liberae.

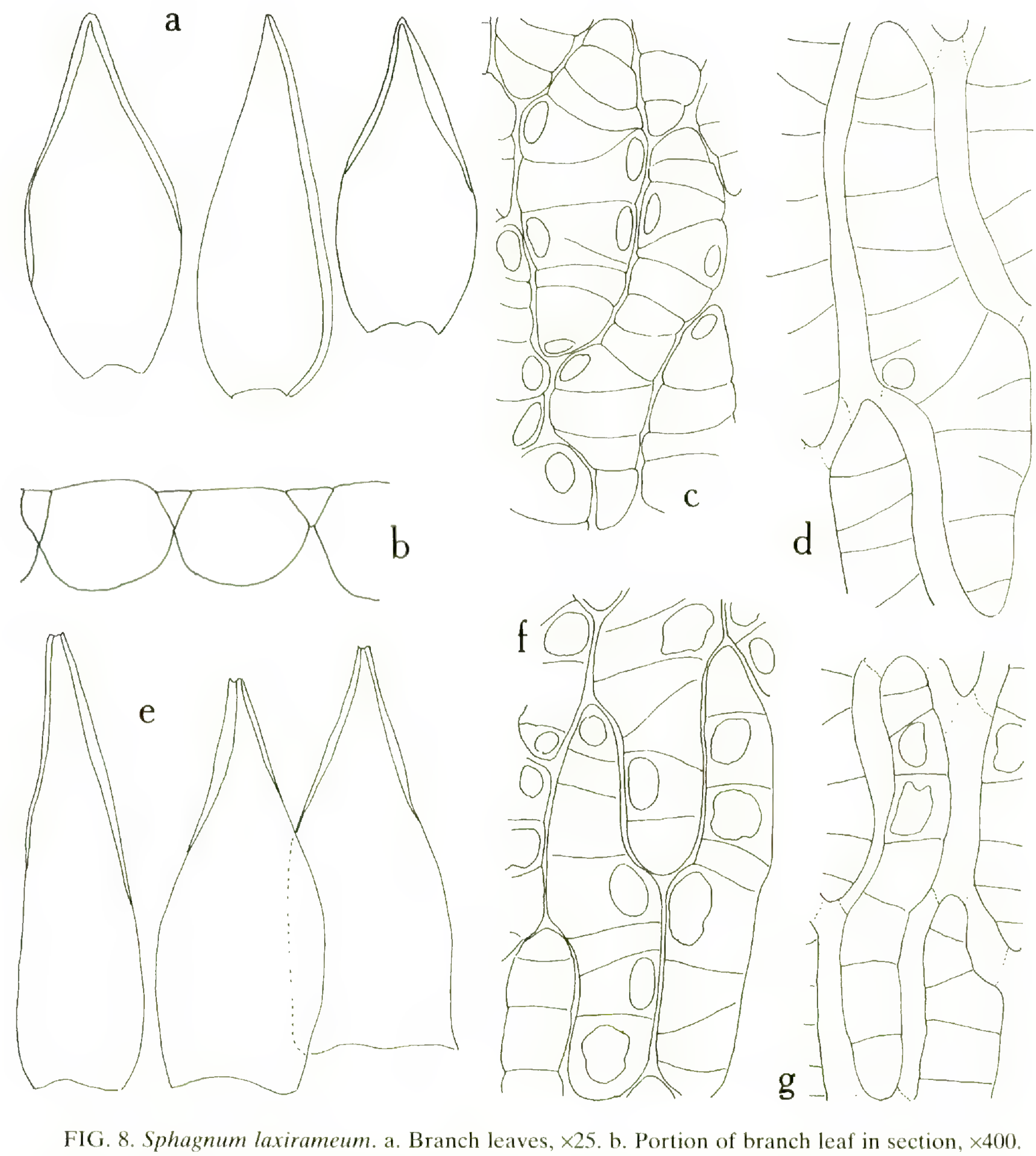



FIG. 8. *Sphagnum laxirameum*. a. Branch leaves, ×25. b. Portion of branch leaf in section, ×400. c. Upper cells of branch leaf, outer surface, ×400. d. Upper cells of branch leaf, inner surface, ×400. e. Stem leaves, ×25. f. Upper cells of stem leaf, outer surface, ×400. g. Upper cells of stem leaf, inner surface, ×400.

Plants slender but elongate, pale-green, ca. 16 cm high, with a small capitulum and well-spaced branch fascicles. Stems pale; cortical cells elongate, some of them porose at their upper ends; wood cylinder yellowish. Stem leaves much like branch leaves in size and shape, 2–2.3 mm long, concave, ovate or oblong-ovate, narrowly bordered, the border not expanded at base; hyaline cells fibrillose in the upper 1/2

or 2/3, mostly 1-divided toward the base, on the outer surface with 1–5 rounded-elliptic, thin-margined pores at commissures and angles, on the inner surface with 1–2 round, porelike gaps, toward the apex in the lower half with rounded gaps of nearly cell width 1–2 per cell or cell compartment. Branches in fascicles of 3 (1 pendent). Branch leaves not ranked, somewhat spreading when dry, concave and often ± hooded at the apex, fibrillose to the base, 1.8–2 mm long, broadly oblong-ovate, narrowly bordered; hyaline cells on the outer surface with numerous narrowly elliptic, somewhat ringed commissural pores, on the inner surface with pores none or very few, rounded, and thin-margined; green cells in section broadly triangular, exposed exclusively or more broadly on the inner surface, the hyaline cells somewhat convex on the inner surface, bulging on the outer.

COLOMBIA. Dpto. Cundinamarca: Mpio. Pacho, carretera Zipaquira–Pacho, 5°6'N, 74°6'W, 3050 m, cañada a un lado de la carretera, bosque montano alto, *Edgar Linares & Steven Churchill 3740*, 25 August 1992 (holotype, MICH; isotype, NY).

The slender but rather tall, pale green plants have only a suggestion of a capitulum, and the branch fascicles are laxly arranged. The stem and branch leaves are rather similar and relatively large (1.8–2.3 mm long). The stem leaves are narrowly bordered to the base, with hyaline cells fibrillose and porose in the upper half or more and mostly 1-divided toward the base, on the inner surface with 1–2 broad, rounded gaps (nearly cell width) in each cell or cell compartment. The branch leaves are often cucullate at the narrow apex.

**Sphagnum** [sect. *Acutifolia*] **fraudulentum** Crum, sp. nov. Fig. 9.

Plantae 5–8 cm altae, roseae vel rufae. Hyalodermis caulis stratis 2–3; cellulae epidermidis superficie exteriore raro porosae; cylindrus lignosus roseus. Folia caulina 1.6–2 mm longa, concavo-acuminata, basi oblonga, usque ad basin anguste limbata, superne fibrillosa; cellulae hyalinae non septatae, superficie exteriore superne poris magnis vel lacunis 5–8 ad commissuras et in medio dispositis, interiore poris 0–2, utrinque ad basin 1–3 lacunis rotundis. Rami 3-fasciculati. Folia ramulina laxe patentia, saepe subsecunda, 2 mm longa, concava, ovato-acuminata, usque ad basin fibrillosae; cellulae hyalinae superficie exteriore poris 5–6, ellipticis, annulatis ad apices et commissuras, ternis in angulis dispositis, interiore poris nullis vel singulis; cellulae chlorophylliferae triangulo-trapezoideae, pariete interiore longiore.

Plants 5–8 cm high, bright red to pink. Stem cortex 2–3-layered, not or rarely porose at the surface; wood cylinder deep pink. Stem leaves 1.6–2 mm long, concave-acuminate from an oblong base, narrowly bordered to the base, fibrillose in the upper 2/3; hyaline cells not divided, on the outer surface in the fibrillose upper portion with 5–8 rounded-elliptic, commissural or median pores or porelike gaps (often nearly as wide as the cell), on the inner surface with 0–2 rounded gaps, toward the base with 2–3 rounded gaps on the outer surface and 1–2 on the inner. Branches 3-fasciculate (2 spreading); retort cells short-necked. Branch leaves loosely spreading and often ± secund, 2 mm long, concave, ovate-acuminate, fibrillose to the base; hyaline cells on the outer surface with 5–6 narrowly elliptic, ringed pores at ends and commissures, close-set in 3's at adjacent angles, on the inner surface with pores none or rarely a single small end pore; green cells triangular-trapezoidal, exposed more broadly on the inner surface, the hyaline cells convex on both surfaces, more so on the outer.

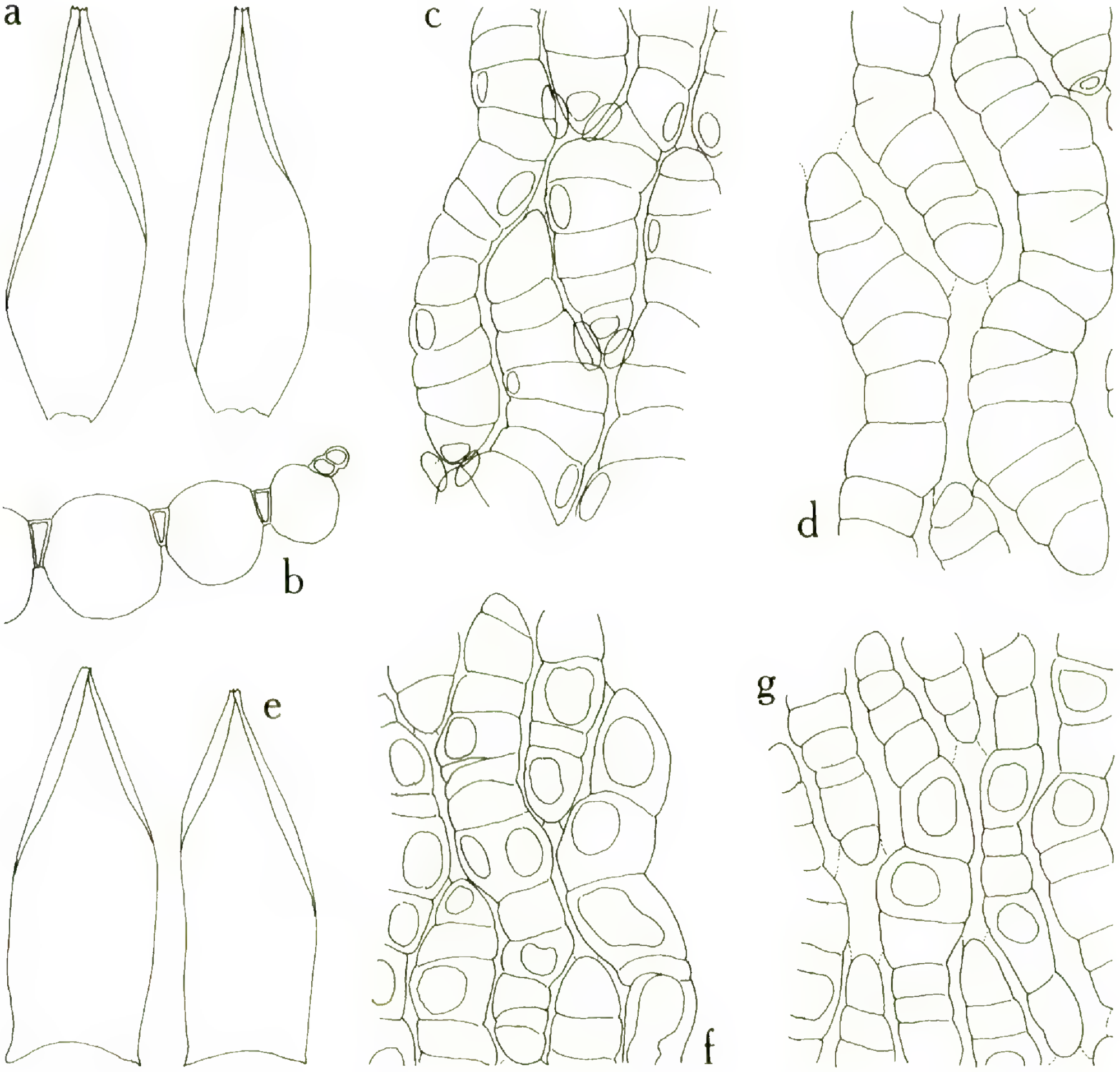



FIG. 9. *Sphagnum fraudulentum*. a. Branch leaves, ×25. b. Portion of branch leaf in section, ×400. c. Upper cells of branch leaf, outer surface, ×400. d. Upper cells of branch leaf, inner surface, ×400. e. Stem leaves, ×25. f. Upper cells of stem leaf, outer surface, ×400. g. Upper cells of stem leaf, inner surface, ×400.

VENEZUELA. Amazonas: Dpto. Río Negro, Cerro de la Neblina, NE end of NW plateau, summit camp no. 10, 12.5 km NNW of Pico Phelps, 16.5 km NE of base camp, 0°54'30" N, 66°2'30"W, 1690 m, *Heliamphora-Neblinaria* savanna with *Euterpe* along drainage streams, *William R. Buck 12910*, 12–13 February 1985 (holotype, MICH; isotype, NY).

*Sphagnum fraudulentum* is so-named because of hemi-isophyllous stem leaves that are deceptively similar to those of *S. tenerum* Sull. It differs from that species in having loosely foliate branches that are not particularly crowded in the capitulum, spreading branch leaves, and rounded, porelike membrane gaps, mostly median in position, on the outer surface of stem leaves.

Contr. Univ. Michigan Herb. 20: 141–146. 1995.

# AN EVALUATION OF DIDYMODON FERRUGINEUS, MORE COMMONLY KNOWN AS BARBULA REFLEXA

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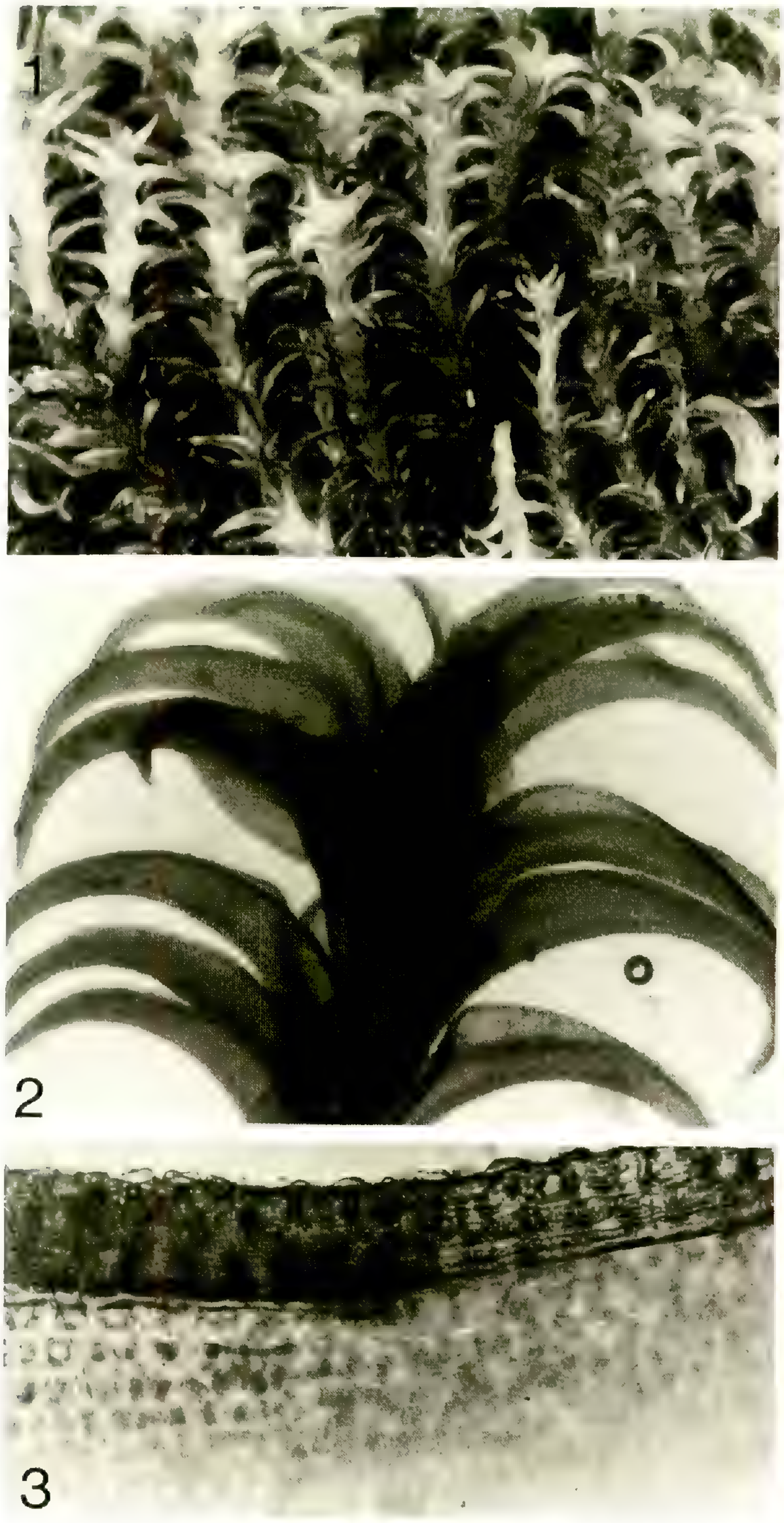
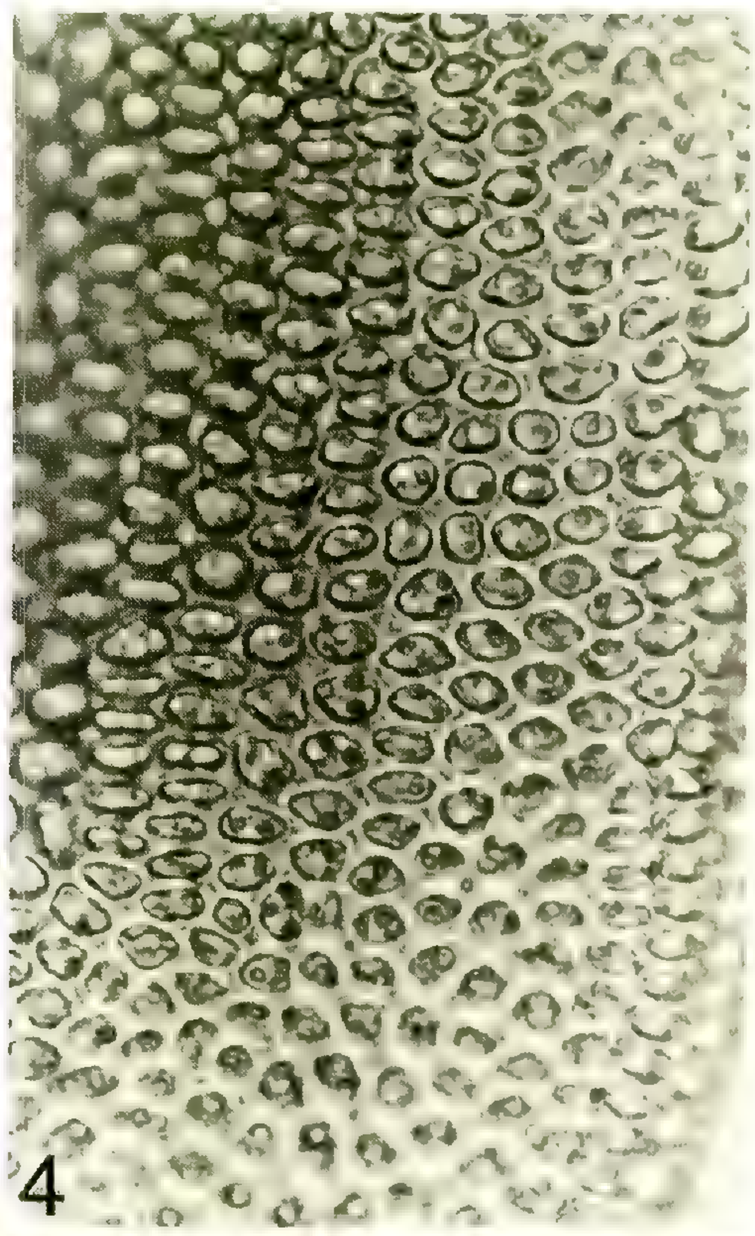
In the summer of 1992, we chanced on a single tuft of *Didymodon ferrugineus* (Schimp. ex Besch.) Hill at the Ramona Beach Hotel near Lake Michigan at Harbor Springs, Emmet County, Michigan. The species, rare in Michigan and elsewhere, had already been found on calcareous substrates on Drummond Island in Chippewa County, offshore from Michigan's Upper Peninsula. The Emmet County plants grew on wet concrete topping a mortared rock channel from an artesian well. Although commonly known as *Barbula reflexa* (Brid.) Brid., the species is better regarded as a *Didymodon* (Hill 1981).

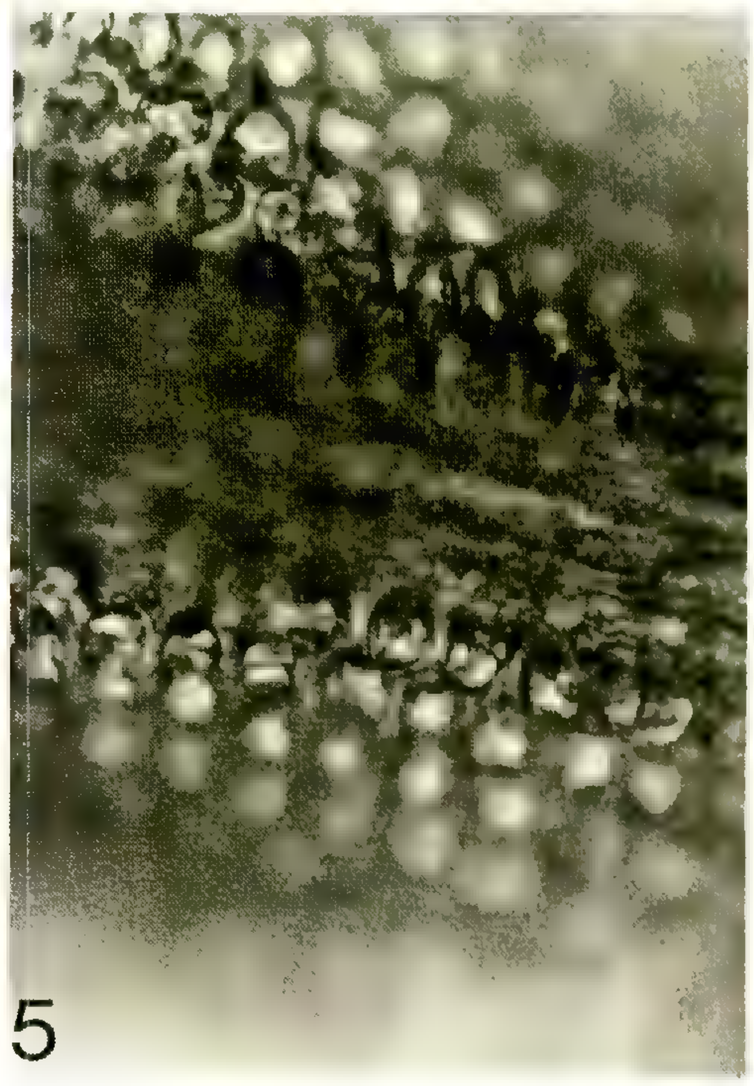
*Didymodon ferrugineus* is remarkably distinctive and immediately recognizable (Figs. 1–5). When moist, its squarrose and conspicuously decurved leaves nicely spiraled in three ranks give the plants a whirligig appearance when viewed from the top. The leaves are slenderly decurrent (but the decurrencies usually remain attached to the stem when leaves are scraped away for examination). One or two small, sharp papillae are seen on both surfaces of leaf cells, and papillae are normally quite evident at back of the costa. The costa has rather well-differentiated guide cells, and the cells covering the upper surface of the costa are elongate, as also in *Didymodon michiganensis* (Steere) Saito and *Barbula fallax* Hedw. The peristome teeth are, at most, 0.6 mm long, and erect or somewhat inclined, and the cells of the operculum are in straight vertical rows.

Incurved leaves and an abundance of tiny, dark-red axillary gemmae give considerable distinction to *Didymodon michiganensis*, but *Barbula fallax* is difficult to define because of its considerable variability and, at best, nondescript character. In any case, it has little resemblance or relationship to *Didymodon ferrugineus*. The leaves of *Barbula fallax* are variously spreading when moist, but not at all squarrose or recurved, its leaf cells are less noticeably papillose, and its costa consists of nearly homogeneous cells. Furthermore, the peristome teeth are quite long, about 1–1.5 mm, and wound together in three to four spirals, and the epidermal cells of the operculum are arranged in distinct spirals.

In spite of a considerable difference from *Barbula fallax*, *Didymodon ferrugineus* has long been considered a close ally of that common and widespread species. Bridel (1806) described the species as *Tortula reflexa* but later (1818) presented it as *Barbula fallax* [var.] *reflexa*. Müller (1848) reduced *B. reflexa* to synonymy with *B. fallax*. Wilson (1855) recognized it as *Tortula fallax* var. *recurvifolia*, and Schimper (1876) called it *Barbula recurvifolia*. Husnot (1884–90) recognized the




FIGS. 1–5. *Didymodon ferrugineus* (syn. *Barbula reflexa*). 1, 2. Plants in side view, showing the conspicuous decurvature of the 3-ranked leaves (×60, ×250). 3. Papillosity at back of the costa, ×400. 4. Upper cells of leaf, showing 1–2 papillae per cell, ×400. 5. Upper portion of costa, ventral surface, showing smooth, elongate cells, ×400.

taxon as *Barbula fallax* var. *recurvifolia*. Boulay (1884) presented it as *B. fallax* **B. recurvifolia* but said it grades insensibly into normal expressions of *B. fallax*, and Dixon (1924) used the same designation. Limpricht (1890), Brotherus (1923), and Chen (1941) gave it specific rank, as *B. reflexa*, as did Steere (1938, 1939), who said, "The species, subspecies, variety, or form, as it has been variously considered by as many authors, is very closely related to *B. fallax*. ...As to the proper category in which to place this moss, it is probably best considered a 'small' species or a subspecies of *B. fallax*." Saito (1975) put the species into *Didymodon*, as *D. rigidicaulis* (C. Müll.) Saito, and perhaps because *Barbula* (or *Didymodon*) *fallax* does not occur in Japan, he made no mention of a relationship

to that species. Zander (1978) also assigned the species to *Didymodon* and regarded it as a mere pigeonhole species. In his opinion, "*D. fallax*, *D. rigidicaulis*, and *D. giganteus* are possibly better recognized as a single polymorphic species because of the large number of plants that are intermediate in character." Elsewhere (1980), he formally recognized the moss as *Didymodon fallax* var. *reflexus* (Brid.) Zand., and for that reason it is so designated in the most recent checklist of North American mosses (Anderson, Crum & Buck 1991). Finally, in his excellent and exhaustive treatment of the family Pottiaceae, Zander (1993) referred the species to *Didymodon ferrugineus* and continued to place *Barbula fallax* in *Didymodon*. It is our opinion that few of the authors who have related *Didymodon ferrugineus* to *Barbula fallax* have seen it in its highly distinctive field habitat or taken into account its obvious microscopic differences from that species.

In Zander's opinion, "very large forms in the Pacific Northwest occasionally grade into *D. giganteus*, or *Geheebia gigantea*." Later (1993), he gave the latter a reduced position as *Didymodon fallax* var. *gigantea*. It is true that *Didymodon ferrugineus*, under optimal conditions, in the Pacific Northwest and Ireland, for example, takes on a much greater size. Such plants have been called variously *Barbula reflexa* var. *robusta* Braithw., *B. maxima* Syed & Crundw., and *Didymodon maximus* (Syed & Crundw.) Hill. Zander (1993) recognized the latter, but the range of size throughout the world scarcely justifies recognizing such large plants as distinct from *Didymodon ferrugineus*. The robust expression of the species encountered in the wetness of coastal British Columbia seems no more significant than the gigantic forms of *Hylocomium splendens* (Hedw.) B.S.G. so common in the same area.

*Geheebia gigantea* (Funck) Jur., of northern Europe, Asia, and North America is quite robust with long, broad leaves (up to 4 or 5 mm long) that are variously spreading but not consistently wide-spreading and certainly not recurved when moist, leaf tips curled and twisted when dry, upper cells very irregularly thickened and almost stellate in outline, and basal cells elongate with pitted walls. In aspect, it is not unlike a *Leptodontium*, but its structure places it in the relationship of *Didymodon ferrugineus* and not *Barbula fallax*. The species is sometimes known as *Barbula gigantea* Funck, but Saito (1975) related it to *Didymodon*. Zander (1993) called it *D. fallax* var. *giganteus* (Funck) Boul., but we see a close relationship to *D. ferrugineus*.

A reasonably complete synonymy of *Didymodon ferrugineus* was presented by Hill (1981), but some additional names from Japan can be added to synonymy (Mizushima 1953): *Triquetrella recurvifolia* Dix. & Sak. ex Sak., *T. tenuicaulis* Sak., and *Leptodontium japonicum* Sak. ex Oti. Under *Barbula*, the name *B. reflexa* would stand, but not under *Didymodon* because of an earlier *Didymodon reflexus* Thér. Likewise, *Didymodon recurvifolius* (Tayl.) Wils. precludes the use of *Barbula recurvifolia* Schimp. as a basionym. *Didymodon rigidicaulis* (C. Müll.) Saito is unavailable as it is based on *Barbula rigidicaulis* C. Müll., described much later than *B. ferruginea* Schimp. ex Besch.

*Barbula* and *Didymodon* have long been separated in spite of overlapping characters, especially of the gametophyte. However, the genera have most commonly been given sporophytic definitions, *Barbula* having a well-developed peristome of 32 long, filiform divisions that are spirally wound together as much as three or four times and *Didymodon* with shorter, erect or slightly inclined divisions. These are the generic concepts held by Limpricht (1890), Brotherus (1923), Chen (1941), Steere (1938, 1939), and Crum and Anderson (1981), to mention but

a few authors. Actually, they date back to Hedwig, nearly two centuries ago. To an extent, such sporophytic definitions allow for a puzzling distribution of gametophytic characters and unnatural assemblages, particularly in *Barbula*. More importantly, the fact that the plants are dioicous and therefore commonly barren causes difficulties in generic assignments, and many species known only in a sterile state have been put into one genus or the other because of gametophytic similarities to some species of dubious relationship already given tongue-in-cheek generic assignment. Overlapping gametophytic characters of such heterogeneity scarcely provide useful generic definitions. In our opinion, although the peristomes of both genera show at least some degree of reduction, they delimit the genera better than any gametophytic characters.

Sporophytes are common in *Barbula fallax* but rare in *Didymodon ferrugineus*. We have seen fruiting material of the latter from England, Virginia, British Columbia, and China. In every case, the peristome teeth were of the *Didymodon* type, nearly erect and quite short (rarely as much as 0.6 mm long). Norris and Koponen (1989) reported the species, as *Didymodon rigidicaulis*, from Papua New Guinea and characterized the peristome as twisted in one to two spirals. Two of the collections they cited are represented in the herbarium of the University of Michigan. In one of them, we saw a single old sporophyte unfortunately lacking a peristome. Material from Newfoundland reported by Crum and Anderson (1981) to have a long, twisted peristome proved on re-examination to be *Barbula fallax* instead.

Saito recognized both *Barbula* and *Didymodon*. In his opinion, gametophytes evolved independently from the sporophytes, and *Barbula* especially lacks gametophytic or sporophytic uniformity. He distinguished the genera, to a large extent, on the basis of axillary hairs, those of *Didymodon* having a pale, brownish yellow basal cell in contrast to the completely hyaline cells of *Barbula*. Zander likewise emphasized axillary hairs, although he characterized those of *Barbula* as "often hyaline" throughout. His summary of gametophytic distinctions between the two genera allows for a surprising degree of variance for each character state (axillary hairs, leaf shape, basal leaf cells, areolation at back of the costa, papillosity, and form of propagula, if any), and he allowed the peristome of *Barbula* to vary from absent or rudimentary to long and twisted and that of *Didymodon* from short and weakly twisted to long and twisted. The result is that neither genus was defined with clarity, either gametophytically or sporophytically.

The axillary hairs, very small and troublesome to demonstrate, occur at growing tips of stems and branches and among gametangia. In some instances, they give some indication of basic relationships, but it is difficult to see the selective value of such minute and protected structures of slightly different color and form. The peristome, on the other hand, is obviously functional and subject to natural selection, and in the *Barbula-Didymodon* complex as in all true mosses, evolutionary reductions of the peristome are expectable and easily demonstrated. In *Didymodon ferrugineus* and *D. michiganensis*, the axillary hairs have the faintly yellow-brown basal cell that characterizes the genus *Didymodon*, whereas *Barbula fallax* has uniformly hyaline axillary hairs of the *Barbula* type.

Crundwell and Nyholm (1965) pointed out that "*Didymodon* is distinguished from *Barbula* exclusively on peristome characters. There is no reason in theory why this should not work well, but in practice it is extremely unsatisfactory. There is no general agreement as to exactly what species should be included in *Didymodon*, and however it is defined its acceptance leads to the generic separation of

closely related species." In accordance with such views, Dixon (1924), Nyholm (1956), and Smith (1978) have recognized a polymorphous *Barbula* inclusive of *Didymodon*. In the interest of practicality, a single genus might seem more workable than two genera of dubious composition. Yet, the resultant complex of species would be patently unnatural in composition, polyphyletic in origin, and even more difficult to define than its component genera are. It is our opinion that the peristome and, to a lesser extent, the axillary hairs give adequate definition to the two genera, poorly defined as they continue to be.

On the basis of specimens at the University of Michigan, New York Botanical Garden, and New Brunswick Museum, we can confirm the distribution of *Didymodon ferrugineus* in southeastern Alaska; coastal British Columbia (including the Queen Charlotte Islands); Mackenzie District of the Northwest Territories; Quebec and New Brunswick; Montana; Michigan, New York, Pennsylvania, Virginia, West Virginia, and Tennessee; Mexico (Distrito Féderal, Puebla, and Querétaro); China, Japan, and India (Himalayas); Papua New Guinea; Sweden southward to northern Italy; England, Ireland, and Scotland. (Records from Ontario, Vermont, North Carolina, Alberta, and Wyoming, as cited in Crum and Anderson, 1981, need confirmation.)

## Summary and Conclusions

At present, it seems best to recognize both *Barbula* and *Didymodon*, troublesome as they may be, more on the basis of peristome characters than axillary hairs. *Didymodon ferrugineus* is properly berthed in *Didymodon* because of relatively short, more or less straight peristome teeth, short, firm-walled basal leaf cells, and axillary hairs with a short, pale-yellow-brown basal cell. Although its sporophytes are unknown, it seems reasonable to assign *Barbula michiganensis* to *Didymodon*, as *D. michiganensis* (Steere) Saito, as its axillary hairs are also of the *Didymodon* type, but *Barbula fallax* is better retained in *Barbula* because of long, twisted peristome teeth and uniformly hyaline axillary hairs. We see no compelling reason to recognize *Didymodon maximus* (Syed & Crundw.) Hill, and we see *Geheebia gigantea* as a *Didymodon*, more closely related to *D. ferrugineus* than to *Barbula fallax*.

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# REVISION OF ODONTONEMA (ACANTHACEAE) IN MEXICO

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*Odontonema* Nees comprises about 30 species of shrubs occurring from northern Mexico southward throughout Central America and the West Indies to southeastern Brazil. Several species are commonly cultivated for ornament under glass in temperate regions and out-of-doors in warm regions worldwide. In the only comprehensive treatment of the genus since that of Nees (1847, as *Thyrsacanthus* Nees), an unpublished M. Sci. thesis by Baum (1982a), 26 species were recognized on the basis of morphological characteristics obtained solely from herbarium specimens. Eight of these species were recorded from Mexico.

The history of names applied to this genus, including accounts (sometimes contradictory) of typification of *Odontonema* were provided by Baum (1982a), Baum and Reveal (1980, 1982), and Baum, Reveal, and Nowicke (1983). Lindau (1895) included the genus in subfamily Acanthoideae, tribe Odontonemeae, subtribe Odontoneminae, along with several other American genera, including *Oplonia* Raf. (as *Anthacanthus* Nees) and *Chileranthemum* Oerst. *Odontonema* was distinguished primarily by its lack of axillary spines and its paniculate inflorescences with long and gradually expanded corolla tubes. The morphologically similar genus *Pseuderanthemum* Radlk. was treated by Lindau (1895) in subtribe Pseuderanthemeae. Bremekamp (1965) treated both of these subtribes in subfamily Ruellioideae, tribe Justicieae, subtribe Odontoneminae. Although Bremekamp's (1965) classification was, by his own admission, both tentative and speculative, it has the advantage of uniting in a single taxon the four similar genera treated by Lindau in two subtribes.

Among New World genera of subtribe Odontoneminae, *Odontonema* is most similar to *Chileranthemum*, *Oplonia*, *Pseuderanthemum*, and *Pulcranthus* V. M. Baum, Reveal & Nowicke. All have an androecium of two dithecous stamens and two staminodes, tricolporate (rarely tetracolporate) and hexapseudocolpate (rarely octapseudocolpate) pollen, and a stipitate capsule with an hour-glass shaped head bearing four seeds. Heterostyly has been documented in each of these genera except *Pulcranthus*. A chromosome number of $n$=21 is also known in *Odontonema*, *Oplonia*, and *Pseuderanthemum* (Daniel & Chuang 1993; Daniel et al. 1990). Chromosome numbers are not known for *Chileranthemum* and *Pulcranthus*. Distinctions among these five genera appear to pertain primarily to differences in form of the corolla, which likely represent adaptations for different floral visitors. Figure 1 illustrates a typical corolla representative of four of these genera. (Corollas of *Oplonia*, which are not shown, are very similar to those of *Chileranthemum*).

Baum (1982a) briefly discussed four major phenetic/phylogenetic groups of species within *Odontonema*. Three of these groups are represented by Mexican species. *Odontonema callistachyum* and its relatives (*O. auriculatum*, *O. cuspidatum*, *O. glaberrimum*, and *O. tubaeforme*) are characterized by their relatively

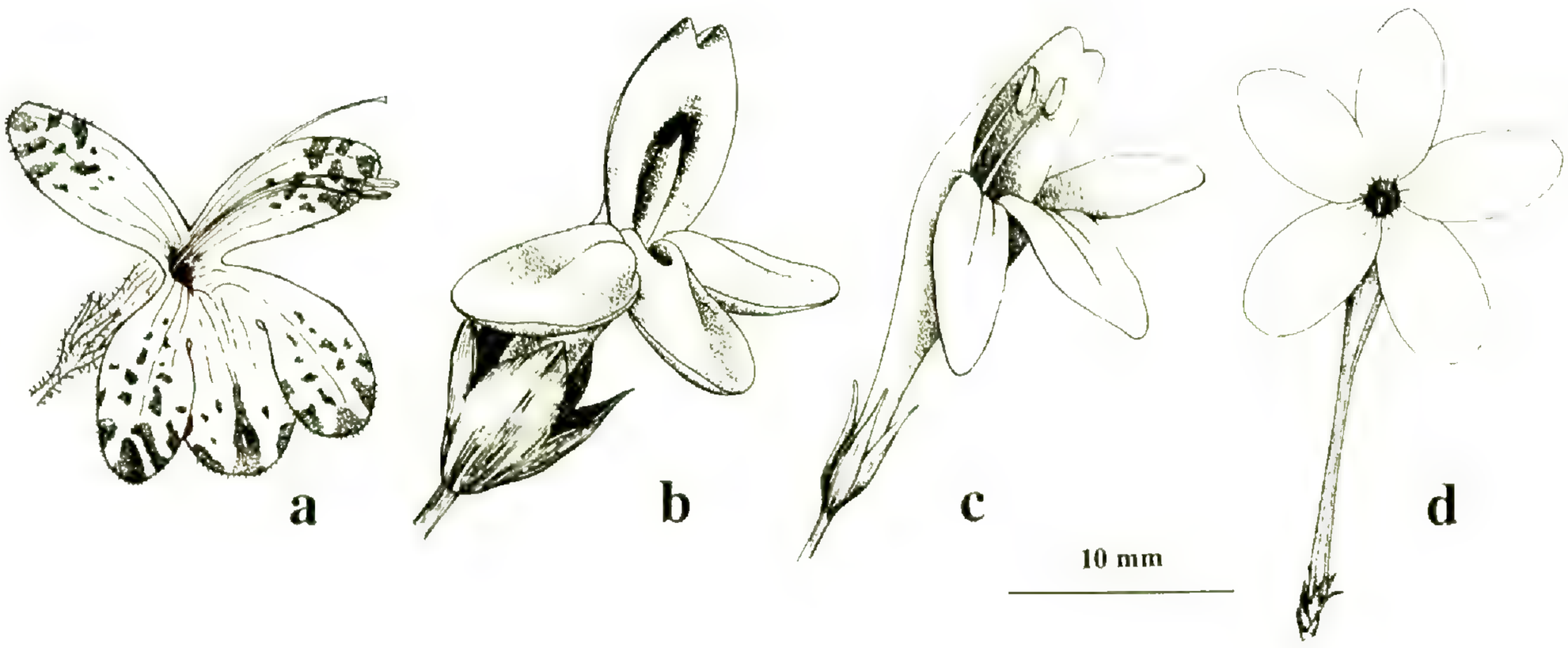


FIG. 1. Corollas typical of four genera of Odontoneminae. a. *Pulchranthus surinamensis* (Bremek.) V.M. Baum, Reveal & Nowicke (redrawn from Baum 1983). b. *Chileranthemum pyramidatum* (Lindau) T. F. Daniel. c. *Odontonema glaberrimum*. d. *Pseuderanthemum verapazense* Donn. Sm. Scale applies to all figures.

large, red to pinkish purple corollas. A group including *O. glabrum* and *O. mortonii* differs primarily by its yellow corollas. *Odontonema albiflorum* was included in a group with white to purple corollas.

Aside from the presence of distyly in all eight species of Mexican *Odontonema*, relatively little is known concerning reproductive biology in this genus. Flowers of Mexican species in the *O. callistachyum* complex all appear to be adapted for pollination by hummingbirds. Corollas are brightly colored, have a well-developed tube with an open throat, lack nectar guides and detectable fragrances, and possess ample quantities of nectar. Styles and Freeman (1993) noted hummingbird visitation to and pollination of "*O. callistachyum*" in Costa Rica. (Because *O. callistachyum* is not known from Costa Rica, their data likely pertain to *O. tubaeforme*.) Plants they studied had a daily secretion of 16 µm of sucrose-dominant nectar. Hummingbird visitation to flowers of *Odontonema* in Mexico has been noted on herbarium labels of *O. cuspidatum* (i.e., *Wendt et al. 2261*) and *O. tubaeforme* (i.e., *McDade 205*). Flowers of other Mexican species differ by their paler (yellow and white) corollas that sometimes possess purplish nectar guides. Additional studies and observations on pollination in *Odontonema* and its relatives are desirable in order to better assess the systematic significance of the differences in floral form.

Pollen of all Mexican species of *Odontonema* was examined with a scanning electron microscope. Grains (Figs. 2, 3) resemble those of related taxa in the Odontoneminae: shape varies from spheric to prolate (sometimes within the same collection); size ranges in length (polar diameter) from 33 to 62 µm and in width (equatorial diameter) from 31 to 48 µm; the exine comprises a homobrochate reticulum; and, for the most part, there are three primary apertures (colpori) and six subsidiary apertures (pseudocolpi). Also, as in some other Odontoneminae, the pseudocolpi of adjacent apertures sometimes fuse toward the poles, resulting in pseudocolpal ellipses in the mesocolpia. Only *O. cuspidatum* (Fig. 2c, d), which has four colpori and eight pseudocolpi, differs from this common pattern. In her survey of pollen in 20 species of *Odontonema*, Baum (1982a) also noted the exceptional grains of *O. cuspidatum*.

The following revision is based on study of herbarium specimens, scanning electron microscopic examination of pollen, and field observations. It differs from

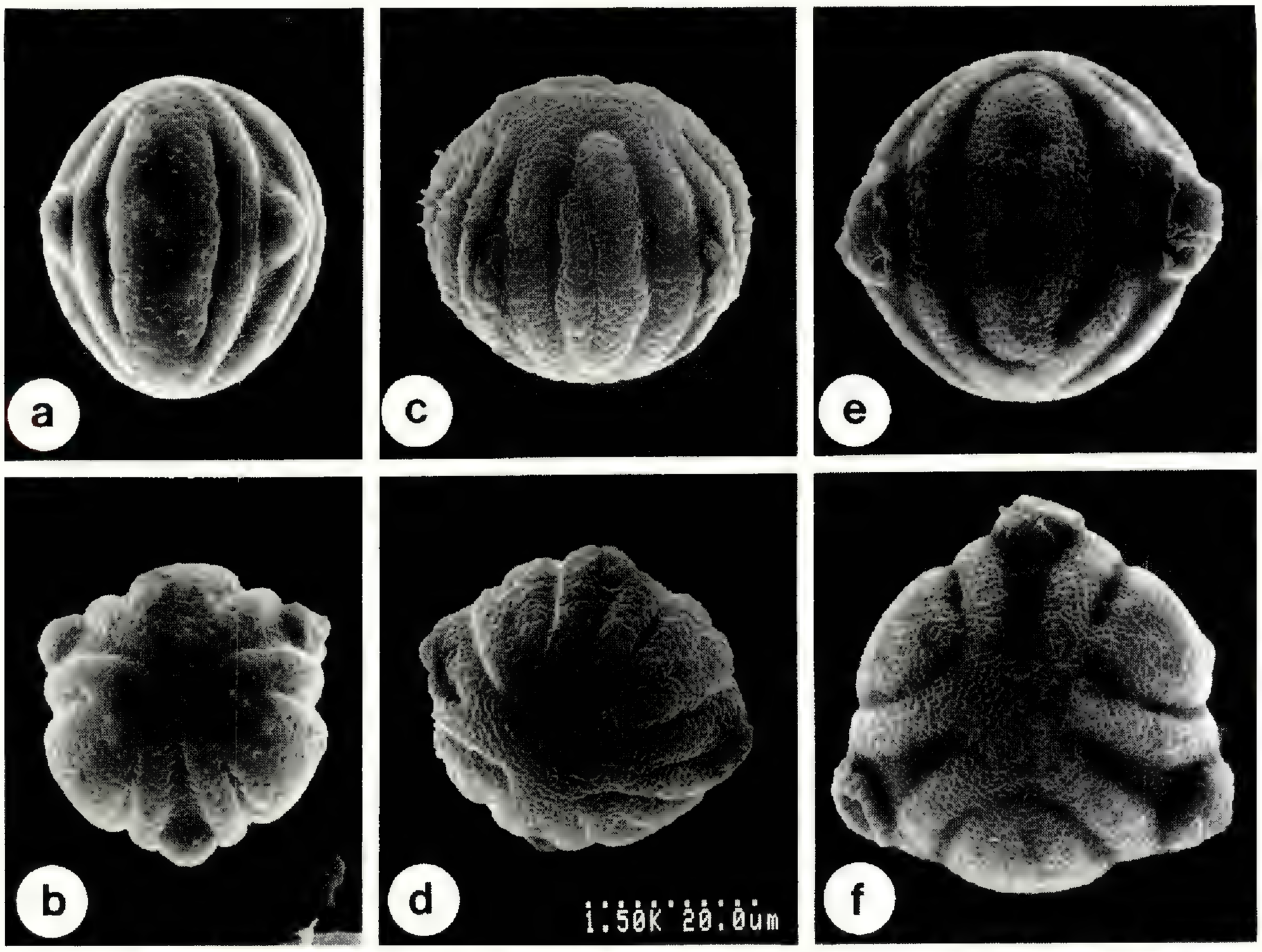


FIG. 2. Pollen of three species of *Odontonema*. a, b, *O. albiflorum* (*Téllez & Villaseñor 6634*): a, intercolpal view; b, polar view. c, d. *O. cuspidatum* (*Breedlove & McClintock 23784*): c, intercolpal view; d, polar view. e, f, *O. mortonii* (*Alexander 444*): e, intercolpal view; f, polar view. Scale applies to all figures.

that of Baum (1982a) by recognizing *O. auriculatum*, treating *O. amicorum* as a synonym of *O. tubaeforme*, treating *O. breedlovei* as a synonym of *O. callistachyum*, adding and realigning several synonyms, and utilizing different suites of characters for distinguishing species. Future studies will need to address the questionable generic distinctions among *Odontonema* and its close relatives noted above.

## TAXONOMY

**Odontonema** Nees, Linnaea 16: 300. 1842, nom. cons. *Thyrsacanthus* Nees in Mart., Fl. bras. 9: 97. 1847, nom. superfl.—TYPE: Garden specimen without date or collector (GZU), type cons.

*Diateinacanthus* Lindau, Bull. Herb. Boissier, ser. 2, 5: 369. 1905.—TYPE: *Diateinacanthus hondurensis* Lindau [=*Odontonema hondurense* (Lindau) D. N. Gibson].

Erect, caulescent, perennial herbs or shrubs (rarely, and probably erroneously, reported as lianas) with cystoliths. Leaves opposite, sessile to petiolate, margin entire to crenate. Inflorescence of contracted or expanded dichasia in axils of bracts, collectively forming a loose to dense, sometimes basally branched, usually terminal spike (i.e., dichasia and flowers sessile), raceme (i.e., dichasia sessile and flowers pedicellate), or thyrse (i.e., dichasia pedunculate); dichasia alternate to opposite to whorled at inflorescence nodes, 1–many-flowered (i.e., 18 or more

FIG. 3. Pollen of three species of *Odontonema*. a, b, *O. callistachyum* (*Daniel & Bartholomew 5014*): a, colpal view; b, polar view. c, d, *O. glabrum* (*Breedlove & Bourell 67391*): c, colpal view; d, polar view. e, f,. *O. tubaeforme*: e, intercolpal view (*Daniel & Bartholomew 4991*); f, polar view (*Hoover 137*). Scale applies to all figures.

flowers), sessile or pedunculate. Flowers heterostylous, usually pedicellate, subtended by 2 bracteoles. Calyx deeply 5-lobed, lobes equal. Corolla white, yellow, purple, pink, or red, externally glabrous or pubescent, internal surface of limb covered with sessile to subsessile glands (in ours), tube usually expanded distally into a prominent throat, limb subactinomorphic to bilabiate, upper lip bilobed, lower lip trilobed. Androecium of 2 stamens and 2 staminodes, stamens inserted at base of corolla throat, thrum stamens exserted, pin stamens usually included in throat, anthers dithecous, thecae equal in length, parallel, equally inserted; pollen prolate to spheric, 3- or 4-colporate, each colpus flanked on each side by a pseudocolpus. Thrum style included in corolla tube, pin style exserted from mouth of corolla; stigma ± funnelform (i.e., lobes indistinct) or bilobed, lobes equal or unequal in length. Capsule stipitate, stipe slightly shorter than or nearly equaling head in length, head obovoid to subellipsoid (often with a medial constriction). Seeds 4 per capsule, borne on hooklike retinacula, lenticular, lacking trichomes. Base chromosome number: $x = 21$.

A genus of 29 species restricted to the New World tropics and subtropics with eight species in Mexico (Baum 1982a, 1982b; Daniel 1986; Wasshausen 1992). Both *O. hondurense* (Lindau) D. N. Gibson (Belize, Guatemala, Honduras) and

*O. steyermarkii* Leonard (Guatemala) might be expected to occur in Mexico (e.g., Chiapas) but have not been collected there. The former differs from known Mexican species by its yellow flowers in branching panicles; the latter differs by its nearly glabrous inflorescence with salmon-pink flowers in pedunculate dichasia.

## Key to the Mexican Species of Odontonema

1. Corolla red or pinkish purple.
   2. Corolla pinkish purple; rachis densely and evenly pubescent. *O. callistachyum.*
   2. Corolla red; rachis glabrous or sparsely pubescent, the trichomes sometimes concentrated in 2 or more lines.
      3. Leaves sessile, auriculate at nodes. *O. auriculatum.*
      3. Leaves subsessile to petiolate, not auriculate.
         4. At least some, usually most, dichasia whorled at inflorescence nodes; rachis pubescent with flexuose to retrorse to appressed trichomes 0.2–1 mm long, trichomes usually concentrated in 2 or more lines; corolla throat 9–13 mm long. *O. tubaeforme.*
         4. Dichasia opposite at inflorescence nodes; rachis glabrous or evenly pubescent with erect to flexuose to antrorse trichomes 0.05–0.5 mm long; corolla throat 3–10 mm long.
            5. Dichasia sessile (rarely subsessile with peduncles to 1 mm long); upper lip of corolla 6–13 mm long; lower lip of corolla 6.5–14 mm long; pollen 3-colporate. *O. glaberrimum.*
            5. Dichasia subsessile to pedunculate (at least some, usually most, dichasia clearly pedunculate in each inflorescence, the peduncles up to 25 mm long); upper lip of corolla 2–5 mm long; lower lip of corolla 2.5–6 mm long; pollen 4-colporate. *O. cuspidatum.*

1. Corolla entirely yellow or pale blue to white with purplish markings on lower lip.
   6. Young stems evenly puberulent with retrorse (to flexuose) eglandular trichomes; rachis, abaxial surface of bracts, and style pubescent; corolla pale blue to white with purplish markings on lower lip, 10–17 mm long; dichasia mostly whorled (opposite proximally) at inflorescence nodes; thecae 1.5–1.9 mm long. *O. albiflorum.*
   6. Young stems glabrous (or rarely in *O. mortonii* some internodes sparsely bifariously pubescent with antrorse eglandular trichomes); rachis, abaxial surface of bracts, and style glabrous; corolla yellow, lacking markings on lower lip, 22–32 mm long; dichasia opposite; thecae 2.3–3.1 mm long.
      7. Inflorescence of ± contracted dichasiate racemes (or panicle of racemes); dichasia sessile (or subsessile, i.e., borne on peduncles to 0.5 mm long); thecae 2.3–2.5 mm long; Oaxaca. *O. mortonii.*
      7. Inflorescence of expanded and open thyrses; dichasia pedunculate, peduncles (1.5–) 4–34 mm long; thecae 2.6–3.1 mm long; Chiapas and Guatemala. *O. glabrum.*

**Odontonema albiflorum** Leonard, Publ. Carnegie Inst. Wash. 461: 219. 1936.—Type: Guatemala. Alta Verapaz: Cubilquitz, 350 m, Feb 1901, *von Tuerckheim 7937* (holotype: US!; isotype: US!).

Shrub to 1 m tall, young stems subquadrate to quadrate-sulcate, evenly puberulent with retrorse (to flexuose) eglandular trichomes 0.05–0.2 mm long. Leaves petiolate, petioles to 13 mm long, blades ovate-elliptic to obovate-elliptic, 160–415 mm long, 58–135 mm wide, 2.1–3.6 times longer than wide, acuminate to falcate at apex, attenuate at base and often somewhat auriculate at apex of petiole, surfaces puberulent with mostly straight (to antrorse) eglandular trichomes less than 0.05–0.1 (–0.2) mm long, trichomes usually restricted to midvein or major veins. Inflorescence of dense, terminal (and sometimes axillary), pedunculate, unbranched (rarely branched at base) dichasiate spikes or racemes to 150 mm long, 5–16 mm in diameter near midspike, rachis puberulent with erect to antrorse to antrorsely

appressed eglandular trichomes 0.05–0.5 mm long; dichasia mostly whorled (opposite proximally) at nodes, 3- or more-flowered, sessile. Bracts often subfoliose (e.g., ovate-lanceolate) proximally, soon becoming subulate, bracts near middle of inflorescence subulate, 2.5–3.8 mm long, 0.8–1 mm wide, abaxial surface pubescent like rachis. Bracteoles and secondary bracteoles triangular to triangular-subulate, 1.5–3 mm long, 0.7–1 mm wide, abaxial surface pubescent like bracts. Flowers sessile or pedicellate, pedicels 1.5–5 mm long, nearly glabrous or sparsely puberulent. Calyx 2–3 (–5) mm long, tube 0.3–0.8 mm long, lobes subulate, 1.5–2.3 (–4) mm long, 0.5–0.8 mm wide, abaxially glabrous or nearly so. Corolla pale blue to white with purplish markings on lower lip, 10–17 mm long, externally glabrous (although margins of lobes ciliolate), tube 7–10 mm long, distally barely expanded into a throat, throat 2.5–4 mm long, 1.5–2 mm in diameter (measured flat) near midpoint, upper lip 5.3–7 mm long, lobes elliptic, 2–4.5 mm long, 1.3–1.9 mm wide, lower lip 5.5–7 mm long, lobes linear-elliptic, 4–5.5 mm long, 2–2.5 mm wide. Thrum stamens 7–9.5 mm long, pin stamens 2.5 mm long, thecae 1.5–1.9 mm long; pollen 3-colporate; staminodes 0.6–1.5 mm long. Thrum style 4–5 mm long, pin style 9–12 mm long, the style proximally (or ± throughout) pubescent with eglandular trichomes; stigma 0.2 mm long, lobes indistinct. Capsule 18–25 mm long, glabrous, stipe 9–13 mm long, head 9–12 mm long. Seeds 3.5–4 mm long, 2.5–3 mm wide, surface rugose to tuberculate; outline of seed shape unknown. Chromosome number unknown.

Phenology. Flowering: November–May; fruiting: January–May.

Distribution. Mexico (Chiapas; Fig. 4), Belize, Guatemala, and Honduras; in lowland rain forests; 100–520 m (up to 1600 m in neighboring Guatemala).

Additional Specimens Examined. **Mexico.** Chiapas: Mpio. Ocosingo, near ruins of Bonampak at junction of rd from Lacanjá to Echeverría and rd from Chancalá, *Breedlove & Almeda 57975* (CAS); Mpio. Ocosingo, 25 km WSW of Frontera Echeverría and 10 km N of Bonampak, *Davidse et al. 20526* (BM, MEXU); 37 km NW of Bonampak, 6 km NNW of Nuevo Guerrero, *Davidse et al. 20537* (BM, MEXU); Mpio. Ocosingo, 2 km W de Crucero Corozal, camino Palenque–Boca Lacantum, *Martínez S. 10129* (MEXU), *10186* (CAS); Mpio. Ocosingo, en campamento COFOLASA, 24 km SE de Crucero Corozal, *Martínez S. 11174* (MEXU); Mpio. Ocosingo, Crucero Corozal, camino Palenque–Boca Lacantum, *Martínez S. 11508* (MEXU), *12081* (MEXU); Mpio. Ocosingo, 15 km NW de Boca Lacantum camino a Palenque, *Martínez S. 11867* (CAS, MEXU); Mpio. Ocosingo, 2 km SE de Nvo. Guerrero, camino Palenque–Boca Lacantum, *Martínez S. 14674* (MEXU); Mpio. Ocosingo, 2 km SE de Nvo. Guerrero, camino Palenque–Boca Lacantum, *Martínez S. 16954* (CAS, MEXU); Mpio. Ocosingo, en Crucero Corozal sobre el camino Palenque–Boca Lacantum, *Martínez S. 17760* (CAS, F); Mpio. Ocosingo, Nvo. Guerrero, camino Palenque–Boca Lacantum, *Martínez S. 18105* (MEXU); Mpio. Ocosingo, Río Lacanjá, 3 km S del Centro Arqueológico Bonampak, *Meave et al. B–187* (ENCB, MEXU); near junction of Río Perla and Río Jataté at San Quintín and near Laguna Miramar, *Sohns 1703* (DS, MICH, UC, US); 36–38 km E of Tziscao o 7–9 km E de Amparo Agua Tinta, sobre el camino de Montebello a Bonampak, *Téllez & Villaseñor 6634* (CAS, ENCB, MEXU).

**Odontonema auriculatum** (Rose) T. F. Daniel, Southw. Naturalist 31: 174. 1986.
*Jacobinia auriculata* Rose, Contr. U.S. Natl. Herb. 1: 349. 1895.—Type: Mexico. Colima: without locality, 27–28 Feb 1891, *Palmer 1323* (holotype: US!; isotypes: GH! K! US!).

Shrub (sometimes leaning) to 2 m tall, young stems quadrate, glabrous. Leaves sessile, blades ovate-elliptic to elliptic to subspatulate, 30–216 mm long, 7–87 mm wide, 2.3–4.7 times longer than wide, acuminate to falcate at apex, attenuate or narrowed proximally into a winglike flange, auriculate at node, surfaces glabrous or somewhat scurfy (rarely sparsely pubescent along midrib on abaxial surface). Inflorescence of loose to dense, terminal, pedunculate, basally branched (if at all)

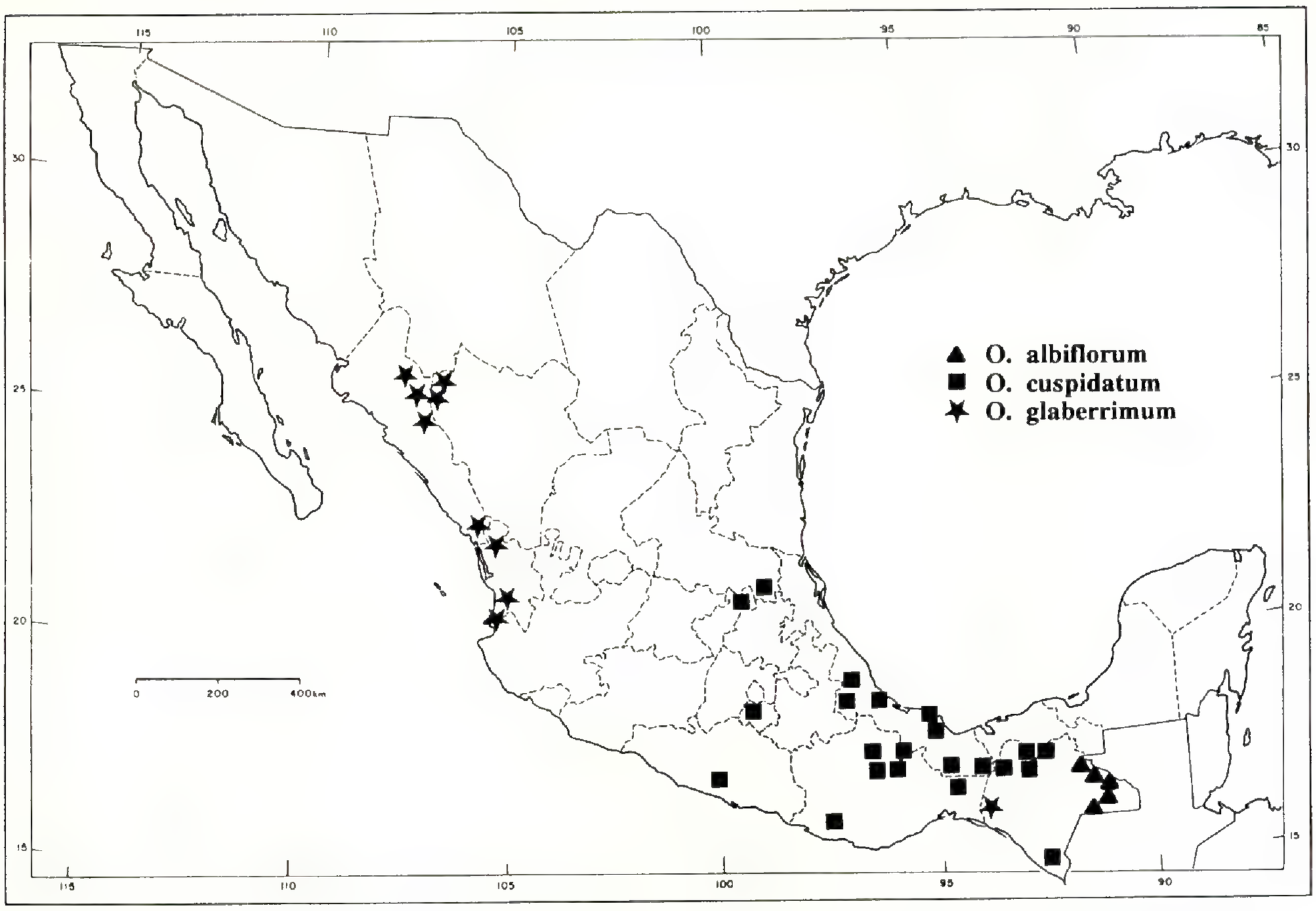


FIG. 4. Distribution in Mexico of *Odontonema albiflorum*, *O. cuspidatum*, and *O. glaberrimum*.

dichasiate thyrses (or with some dichasia occasionally sessile) to 150 mm long, 15–37 mm in diameter near midpoint of fertile portion, rachis glabrous to very sparsely pubescent with inconspicuous eglandular trichomes to 0.05 mm long; dichasia opposite at nodes, usually 3- or more-flowered, (sessile to) pedunculate, peduncles 1–4 mm long, glabrous. Bracts triangular to lance-subulate to subulate, those near middle of inflorescence 1.5–4 mm long, 0.5–1.3 mm wide, abaxial surface glabrous, margin ciliate. Bracteoles and secondary bracteoles triangular to subulate, 1–2 mm long, 0.5–1 mm wide, abaxial surface glabrous. Flowers pedicellate, pedicels 4–10 mm long, glabrous. Calyx 2–5 mm long, tube 0.3–0.8 mm long, lobes triangular-subulate to lance-subulate to subulate, 1.4–4 mm long, 0.5–0.8 mm wide, abaxially glabrous. Corolla red, (20–) 25–30 mm long, externally glabrous, tube 13–20 mm long, gradually to ± abruptly expanded distally into a distinct throat, 4.5–7 mm long, 3–5 mm wide, upper lip (6–) 9–12 mm long, lobes rounded, 1–2.5 mm long, 1–2 mm wide, lower lip (6–) 9–13 mm long, lobes elliptic, (6–) 8.5–11.5 mm long, 2.5–4 mm wide. Thrum stamens 13–15 mm long, pin stamens 6 mm long, thecae 2.2–2.8 mm long; pollen 3-colporate; staminodes 0.5 mm long. Thrum style 10–10.5 mm long, pin style 21 mm long, sparsely pubescent ± throughout; stigma bilobed, lobes equal, 0.1–0.2 mm long. Capsule 18–25 mm long, glabrous, stipe 7–12 mm long, head 10.5–13 mm long. Seeds subcordate in outline, 4–6 mm long, 3.5–4.3 mm wide, surface smooth. Chromosome number unknown.

Phenology. Flowering: January–May; fruiting: February–May.

Distribution. Western and southern Mexico (Colima, Guerrero, Michoacán, Nayarit, Oaxaca; Fig. 5); in tropical deciduous forests and tropical subdeciduous forest; 60–230 m.

Additional Specimens Examined. **Mexico.** Colima: Armeria, *Palmer 1286* (NY, in part).—Guerrero: between Petatlán and Camalotito, 6.9–7.9 mi SW of Camalotito, *Daniel & Bartholomew 4913* (CAS, DUKE, K, MICH); Escuela Agropecuaria, carr. Zihuatanejo–Ixta, *Germán et al. 230*

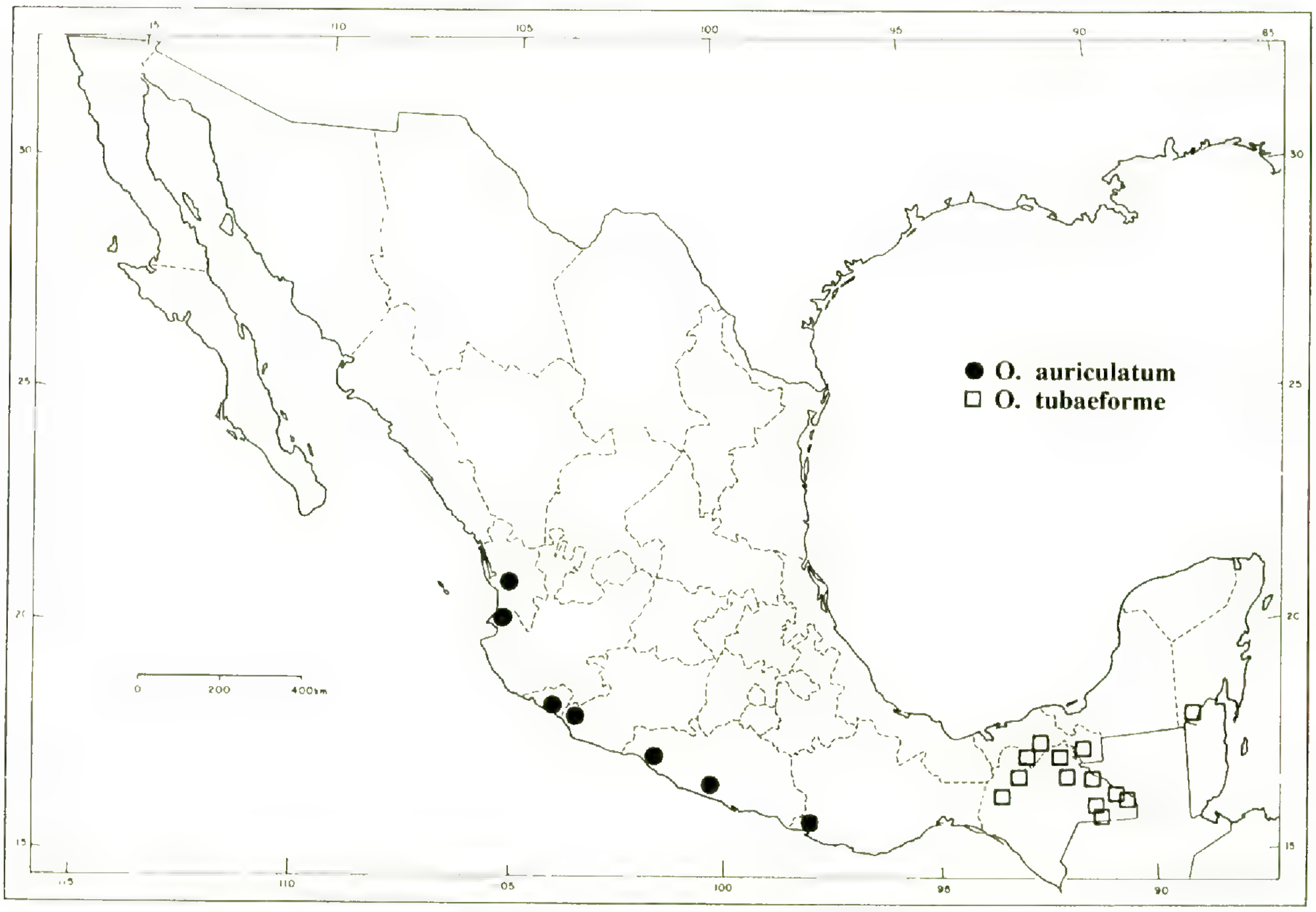


FIG. 5. Distribution of *Odontonema auriculatum*, and of *O. tubaeforme* in Mexico.

(MEXU); Atoyac, *Hinton et al. 11215* (K, MICH, RSA, UC, US).—MICHOACÁN: Chacalapa, *Hinton et al. 13770* (US); Aquila, *Hinton et al. 15812* (K, MICH, RSA, UC, US).—NAYARIT: Mpio. Compostela, 4 km NE de Valle de Bandera, 20°50'N, 105°12'W, *Flores F. & Ruenes 2042* (MEXU, MICH); 3.5 km E de Jumatan, camino a la carr. Tepic–Mazatlán, *Téllez 10260* (MEXU); Mpio. Compostela, El Ahuacate Mocho, 7 km NE de Valle de Banderas, 20°50'N, 105°14'W, *Tenorio L. et al. 15565* (MEXU, MICH).—OAXACA: Pinotepa, *Galeotti 510K* (W).

**Odontonema callistachyum** (Schltdl. & Cham.) Kuntze, Revis. gen. pl. 2: 494. 1891. *Justicia callistachya* Schltdl. & Cham., Linnaea 6: 370. 1831. *Thyrsacanthus callistachyus* (Schltdl. & Cham.) Nees in A. DC., Prodr. 11: 326. 1847.—TYPE: MEXICO. Veracruz: Misantlae, 1828, *Schiede s.n.* (holotype: B, destroyed; probable isotype: W!).

*Thyrsacanthus callistachyus* var. *amplus* Nees in A. DC., Prodr. 11: 326. 1847.—TYPE: MEXICO. Veracruz: Cordillera, 3000 ft, Dec 1840, *Galeotti 926* (lectotype, here designated: K ex hb. Hook.!; isolectotypes: BR, G, P! W!).

*Thyrsacanthus lilacinus* Lindl., J. Hort. Soc. London 6: 159. 1851.—TYPE: plants cultivated under "Justicia lilacina" in Garden of the Horticultural Society of London from an unknown source (presumed to be tropical America) fide Lindley and Paxton in Paxt. fl. gard. 2: 77. 1851 (holotype: CGE, photo US!).

*Thyrsacanthus geminatus* Donn. Sm., Bot. Gaz. (Crawfordsville) 13: 75. 1888. *Odontonema geminatum* (Donn. Sm.) S. F. Blake, Contr. Gray Herb. 52: 104. 1917.—TYPE: GUATEMALA. Alta Verapaz: Pansamalá, 3800 ft, Oct 1885, *von Tuerckheim 740* (holotype: US!; isotypes: F! G, GH! K! M, NY, P! US!). Although Donnell Smith also noted another date in the protologue (i.e., May 1887), the holotype and all isotypes examined bear the earlier date.

*Odontonema breedlovei* V. M. Baum, Brittonia 34: 427. 1982.—TYPE: MEXICO. Chiapas: Mpio. Ocosingo, along streams near Lacanjá, 2 Apr 1973, *Breedlove 34473* (holotype: DS!).

Perennial herb or shrub to 3.5 (–5) m tall, young stems quadrate to quadrate-sulcate, glabrate or sparsely pubescent with flexuose to antrorsely appressed eglandular trichomes 0.2–0.7 mm long, trichomes evenly disposed or concentrated in 2 lines, the stems sometimes also covered with sessile glands less than 0.1 mm in diameter. Leaves petiolate, petioles to 27 mm long, blades ovate to ovate-elliptic to elliptic to obovate-elliptic, 63–300 mm long, 21–163 mm wide, 1.8–4 times longer than wide, acuminate to falcate at apex, acute to attenuate at base, surfaces pubescent with cauline-type trichomes, mostly along midvein, or glabrate. Inflorescence of loose to dense, terminal, pedunculate, often basally branched dichasiate racemes (rarely thyrses) to 600 mm long, 20–220 mm in diameter (including branches) near midpoint of fertile portion, rachis evenly and densely pubescent with antrorse to antrorsely appressed eglandular trichomes 0.2–0.6 mm long; dichasia opposite (rarely whorled) at nodes, 3–18- or more-flowered, sessile (rarely borne on peduncles to 2 mm long), sometimes 2 dichasia present per bract. Bracts lanceolate to subulate to triangular, those near middle of inflorescence 2–8.5 (–13) mm long, 1–3 mm wide, abaxial surface pubescent like rachis. Bracteoles and secondary bracteoles lanceolate to subulate to triangular, 1–6 (–8) mm long, 0.5–2 mm wide, abaxial surface pubescent like bracts. Flowers pedicellate, pedicels often with a purplish cast, 2–12 (–18) mm long, pubescent like rachis. Calyx often with a purplish cast, 2.5–6.5 mm long, tube 0.5–1.2 mm long, lobes subulate, 2–5.7 mm long, 0.3–1 mm wide, abaxially pubescent like rachis or sparsely pubescent with antrorse eglandular trichomes 0.1–0.2 mm long or nearly glabrous. Corolla pinkish purple, (12–) 17–30 mm long, externally glabrous (although margins of lobes ciliolate), tube 6.5–19 mm long, expanded distally into a distinct throat, throat (4.5–) 5–10 mm long, (2.5–) 3–4.5 mm in diameter (measured flat) near midpoint, upper lip (3–) 4.5–11 mm long, lobes rounded to subacute, 1.5–3.5 mm long, 1–3.3 mm wide, lower lip (3–) 4–12.5 mm long, lobes linear to elliptic, (3–) 4–12 mm long, (1.5–) 2.5–4.5 mm wide. Thrum stamens 8–13 mm long, pin stamens 4–6 mm long, thecae 1.5–2.5 mm long; pollen 3-colporate; staminodes 0.6–4 mm long. Thrum style 5–13 mm long, pin style (11–) 13–21 mm long, the style pubescent throughout with eglandular trichomes; stigma 0.2–0.4 mm long, funnelform or equally bilobed. Capsule (10.5–) 15–23 mm long, glabrous, stipe (4–) 6–11 mm long, head (6.5–) 8.5–13 mm long. Seeds subcordate in outline, 3–5 mm long, 2.6–3.3 mm wide, surface rugose (not tuberculate). Chromosome number unknown.

Phenology. Flowering: October–July; fruiting: October–May.

Distribution. Mexico (Chiapas, Guerrero, Hidalgo, Jalisco, Michoacán, Oaxaca, Puebla, Querétaro, San Luis Potosí, Tabasco, Veracruz; Fig. 6), Belize, and Guatemala; in lowland rain forests, montane rain forests, tropical deciduous forests, tropical subdeciduous forests, evergreen seasonal forests, mesophytic montane forests, mixed oak woodlands, and pine-oak forests; 40–2000 m; plants are often cultivated in many parts of Mexico; it is not certain that all of the specimens cited below are from wild plants.

Local names. "Canutillo" (*Williams 8610*); "Cruz nichim" (Tzeltal, *Brett 795*).

Uses. Crushed leaves are used as a plaster for swelling (*Brett 795*).

Unfortunately, the holotype of *O. callistachyum* was destroyed at B. A specimen at W has a label that indicates, "in sylvis Misantlae" and "Mart. G." Added

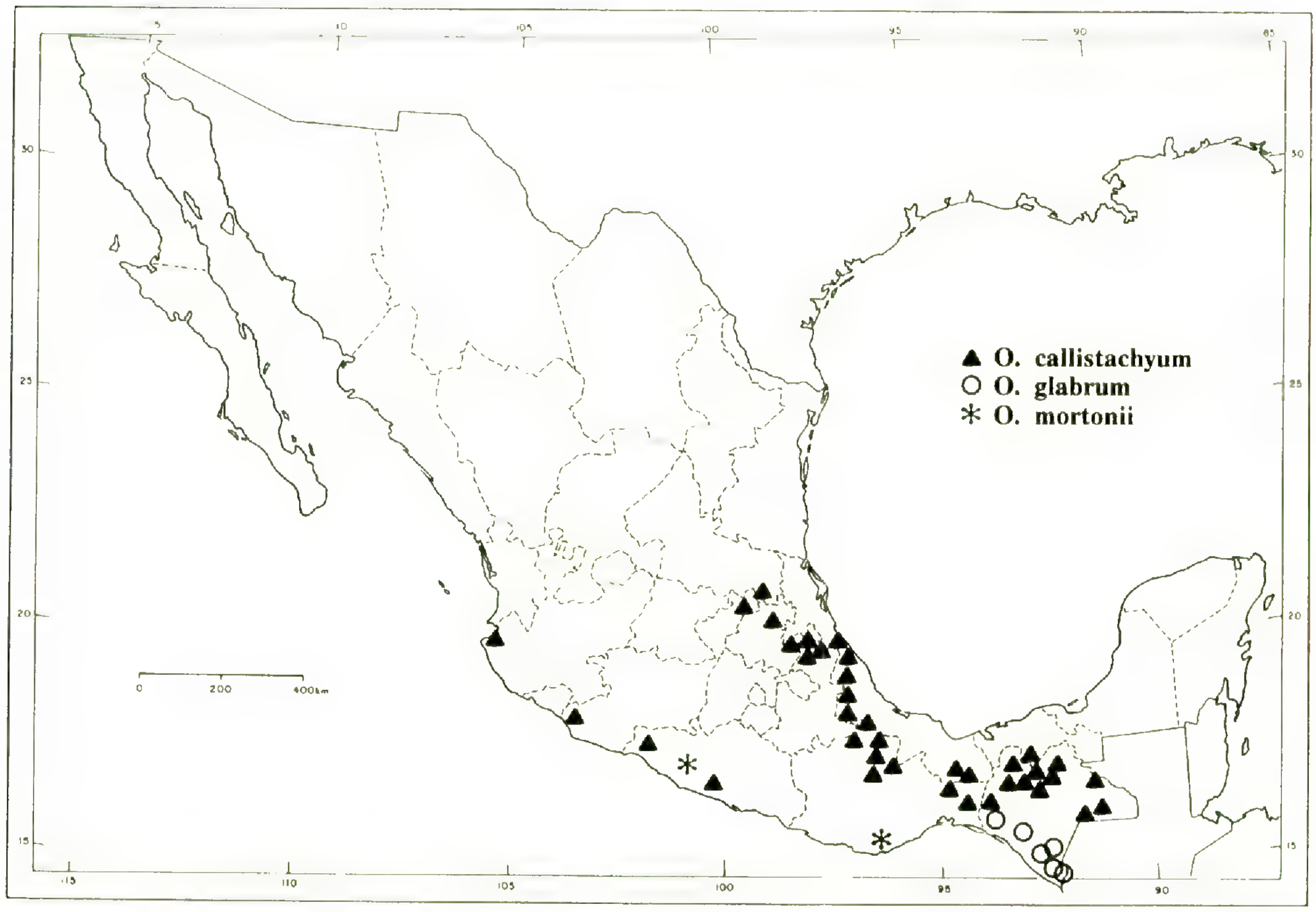


FIG. 6. Distribution of *Odontonema callistachyum* (Mexico only), *O. glabrum* (Mexico only), and *O. mortonii*.

to this information in different inks are "1830/l.B." and "12 Schiede et Deppe." This specimen likely is an isotype.

*Galeotti 926* at K is here chosen as the lectotype of *Thyrsacanthus callistachyus* var. *amplus*. In the protologue Nees also cited, "Claussen! n. 277 et 407 in h. Hooker." In Hooker's herbarium at K there are Jürgensen (not Claussen) specimens 877 (the initial numeral looks very much like a "2") and 407. *Thyrsacanthus lilacinus* is placed in synonymy here, as was done by Leonard (1936). Baum (1982a) did not treat this name. The coloration and form of the corolla as well as the "downy" rachis (fide Paxton reference noted above) readily place this species in *O. callistachyum*. A photograph of the type also looks like *O. callistachyum*.

*Justicia corymbulosa* Bertol., which was included in the synonymy of *O. callistachyum* by Gibson (1974), is discussed below under excluded names.

Baum's (1982a) revision differs significantly from that of Gibson (1974) for the Flora of Guatemala in its treatment of *O. callistachyum* and related species. Gibson included *O. cuspidatum*, *O. steyermarkii*, and *O. tubaeforme* within a variable and widely distributed *O. callistachyum*. She noted that plants in this complex had been separated into various species based on pubescence of the rachis, corolla color, and/or the number of flowers in a dichasium. She did not judge these differences to provide dependable criteria upon which to distinguish species. Although Baum did not specifically address Gibson's treatment, she utilized these characters prominently in recognizing species, including both *O. cuspidatum* and *O. tubaeforme*. Figure 7 shows some of the distinguishing characteristics among *O. callistachyum* and its three closest relatives in Mexico. *Odontonema steyermarkii* is known only from Guatemala and differs from *O. callistachyum* by its glabrous or nearly glabrous rachis, pedunculate dichasia, and salmon-pink corollas.

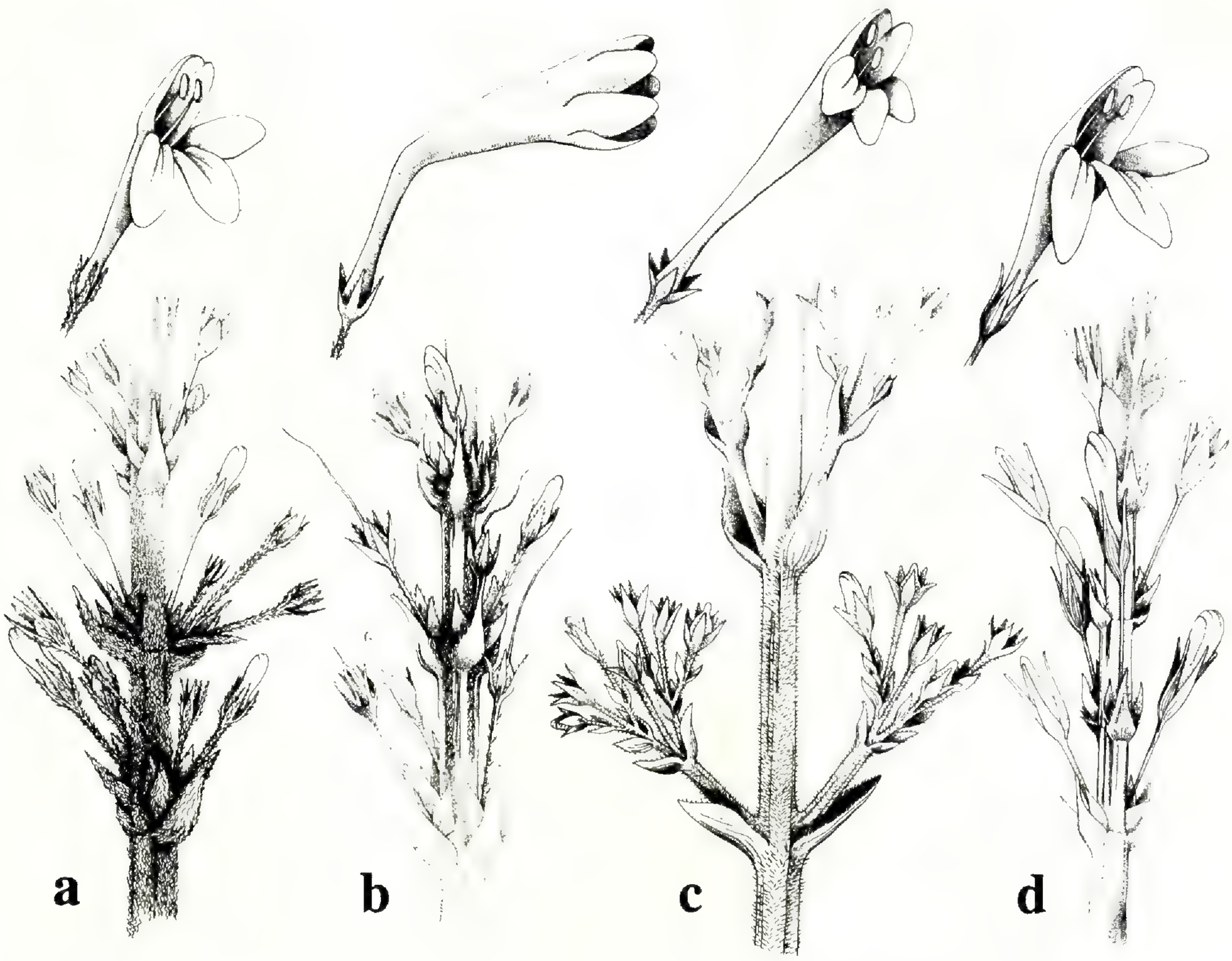


FIG. 7. Comparison among inflorescences and flowers of four species of *Odontonema*. a. *O. callistachyum*, inflorescence (*Breedlove & Keller 49594*), flower (*Breedlove & Almeda 48109*). b. *O. tubaeforme*, inflorescence (*Daniel & Bartholomew 4991*), flower (*Breedlove & McClintock 34236*). c. *O. cuspidatum*, inflorescence (*Wendt et al. 2802*), flower (*Hernández G. 2592*). d. *O. glaberrimum* (*Tenorio L. et al. 8297*). (Inflorescences ×2.4, flowers ×1.5.)

*Odontonema breedlovei* is known only from the holotype. It appears to differ from *O. callistachyum* solely by the corolla color (yellow, as noted on the specimen's label; the original color is not preserved on the few large corollas present) and the somewhat smaller capsules (10.5–14 mm long vs. 15–23 mm long). Either the label data is in error or the plant represents a form of *O. callistachyum* with yellowish corollas. The former explanation appears more likely, because a purplish coloration is evident on pedicels, calyces, small corolla buds, and septae of trichomes in the inflorescence on the type. This coloration is almost universal among specimens of *O. callistachyum* but is not known in Mexican species with yellow or whitish corollas.

*Odontonema callistachyum* exhibits some variation that is suggestive of *O. cuspidatum* and *O. tubaeforme*. The dichasia are very rarely pedunculate (usually when there are two dichasia per bract) as in the former species and in *Hernández G. 569* from Veracruz and *Balogh 944* from Chiapas, the dichasia are whorled as in the latter species. The pinkish purple corollas readily distinguish this species. Even when corolla color is not evident on dried specimens, the purplish color of inflorescence trichomes, pedicels, and calyces often persists and helps to identify the species. Specimens in which the variation is particularly noteworthy are discussed below. Information from them is not included in the description above.

*Thyrsacanthus geminatus* is included under this species with some hesitation. Duplicates of the type exhibit variation in inflorescence pubescence and dichasial placement and form. Knowledge of corolla color would be helpful in placing this name, but no information to that effect is provided on the specimens. On the isotype at F the dichasia are whorled (4/node) and pubescence of rachis is sparse and concentrated in lines. These two features are more suggestive of *O. tubaeforme* than *O. callistachyum*. Although *O. callistachyum* can have whorled dichasia, they are very rare in the species. The isotype at P has all dichasia opposite, a purplish cast to the corollas, and the pubescence of the rachis is similar to that of *O. callistachyum*. In some respects the isotype at US has plants intermediate between *O. tubaeforme* and *O. callistachyum*. Pubescence of the rachis is sparse (but not correct for either), flexuose-antrorse, 0.1–0.4 mm long, and ± evenly disposed, and a purplish cast is evident on some dried corollas. The isotype at K is similar with sparse, antrorse to antrorsely appressed, evenly disposed pubescence, opposite and sessile to pedunculate dichasia, and a purplish cast to the corollas. The holotype has pubescence similar to *O. callistachyum* and whorled, sessile dichasia. *Donnell Smith 1728* was collected in April 1889 from the same locality as the type of *T. geminatus*. On the newer growth, the trichomes are very similar to those of *O. callistachyum*, and it has proximal pedunculate dichasia that may actually represent nascent branches of the inflorescence. Another collection resembling the type of *T. geminatus* is *Miranda 1755* (Chiapas: Barranca Aguas Calientes, US). It combines some features of both *O. callistachyum* and *O. tubaeforme*. It has numerous whorled dichasia; the lower dichasia are pedunculate (possibly representing nascent branches); pubescence of the rachis comprises sparse, ± evenly disposed, flexuose-antrorse eglandular trichomes to 0.1 mm long; and bracts near middle of inflorescence are lance-subulate, 6–7 mm long. Unfortunately the color of the corolla is not known.

Species sometimes occur in close proximity to one another, and the possibility of hybridization exists. The ranges of several species in the *O. callistachyum* complex (including *O. callistachyum*, *O. cuspidatum*, and *O. tubaeforme*) overlap in southern Mexico and northern Central America. Some of the rare and unusual forms noted above of otherwise consistent species may represent hybrids.

Additional Specimens Examined. **Mexico.** Chiapas: 3.4 mi NE of Tziscao Camp, *Balogh 944* (US); Mpio. Tenejapa, paraje of Kotol Te', Yochib, *Breedlove 7359* (DS); Mpio. Tenejapa, paraje of Kulak'tik, barrio of Chana', *Breedlove 7553* (DS, F, MICH, US); Mpio. Tenejapa, paraje of Mahben Chauk, Shaki 'Uk'um, *Breedlove 7585* (DS, F, MICH, US); Mpio. La Trinitaria, Lago Tsiskaw on Guatemala border, 30 mi E of La Trinitaria, *Breedlove 9752* (DS, F, MICH, US); Mpio. Solusuchiapa, 2–4 km below Ixhuatan along rd to Pichucalco, *Breedlove 24173* (DS, MEXU); Mpio. Ocozocoautla de Espinosa, 45 km N of Ocozocoautla just above Malpaso, *Breedlove 32845* (DS, MICH), *Breedlove & Thorne 20747* (DS); Mpio. Las Margaritas, W side of Laguna Miramar E of San Quintín, *Breedlove 33247* (DS); Mpio. Osumacinta, 11–15 km NW of Soyalo on rd to La Bombana and Chicoasén, *Breedlove 33798* (DS); Mpio. La Trinitaria, E of Laguna Tzikaw, Monte Bello National Park, *Breedlove 35159* (DS); 10 km ENE of Dos Lagos above Santa Elena, *Breedlove 48811* (CAS); Mpio. Peltalcingo, Ahk'ulbal Nab above Peltalcingo, *Breedlove 49917* (CAS); Mpio. Peltalcingo, Ahk'ulbal Nab above Peltalcingo, *Breedlove 50444* (CAS); Mpio. Cintalapa, Oaxaca border near La Ciénega de León, *Breedlove & Almeda 48190* (CAS, MEXU); Mpio. Ocosingo, 70 km SW of Palenque on rd to Ocosingo along the Jol Uk'um, *Breedlove & Almeda 48381* (CAS, MEXU), *Breedlove & Keller 49594* (CAS); Mpio. Ocosingo, cascade below Mesbilja about 10 km above Abasolo, *Breedlove & Almeda 57146* (CAS); Mpio. San Fernando, 20 km NW of San Fernando just beyond Colonia Cuauhtémoc, *Breedlove & Bourell 68244* (CAS); Mpio. La Trinitaria, Km 21–23 along rd from Lago Tzicao to Santa Elena, *Breedlove & Daniel 71211* (CAS); Mpio. Jitotol, 5 km SE of Jitotol along rd to Bochil, *Breedlove & Keller 49272* (CAS, MEXU); Mpio. Las Margaritas, confluence of Río Ixcán with Río

Lacantum (Río Jataté) on Guatemala border, *Breedlove & McClintock 34057* (DS, MEXU); Mpio. El Bosque, 7 km NE of the Jitotol–Pichucalco jct on rd from Bochil to Simojovel, *Breedlove & Smith 32497* (DS); Mpio. San Juan Cancuc, Yaal wakax, *Brett 795* (CAS); El Chichón, between Ixtacomitán and Chapultenango, *Burnham 6* (BM); between San Fernando and Moravillas (near Lago Malpaso), 4–66 mi NW of San Fernando, *Croat & Hannon 64983* (BM, CAS); along Hwy 195 between Chiapa de Corzo and Pichucalco, 0.6 mi N of Tapilula, *Croat & Hannon 65256* (CAS); Agua Azul between Palenque and Ocosingo, ca. 10 mi SW of Río Tulija, *Daniel & Bartholomew 5007* (CAS); between Palenque and Ocosingo, 12.2–17.4 mi N jct. rd to Yajalón, *Daniel & Bartholomew 5013* (CAS); between Palenque and Ocosingo, 9.7 mi N of Ocosingo, *Daniel & Bartholomew 5014* (CAS, DUKE, K, MICH); 37 km NW of Bonampak, 6 km NNW of Nuevo Guerrero, *Davidse et al. 20533* (BM, MEXU); Mpio. La Trinitaria, N del Lago Tziscao, *Espejo et al. 3104* (MEXU); Mpio. Tumbalá, Agua Azul, *Fernández N. 1495* (MEXU); La Ceiba, 6 km E de Raudales, *González Q. 3442* (DS, MICH, WIS); 3.6 mi N of Ocosingo on rd to Palenque, *Luckow 2568* (CAS); Mpio. Ishuatan, 9 km N de Tapilula, *Martínez S. et al. 3220* (CAS, MEXU, WIS); Ruina Palenque, *Matuda 3694* (F, K, MICH); between Tumbalá and El Salto, *Nelson 3373* (US); Mpio. Altamirano, 20 km N a Colonia Puebla Nueva, *Pérez M. 215* (CAS, MICH); Xalom Ja', 4 km O de Cancuc, *Sántiz C. 450* (CAS); S. Martin und Ocosingo, *Seler & Seler 2204* (K, US); 3.5 km al E de Tziscao sobre el camino de las Lagunas de Montebello–Bonampak, *Téllez & Villaseñor 6613* (CAS, MEXU); Mpio. Tenejapa, paraje of Mahbenchauk, barrio of Tih Ha', *Ton 1417* (DS, F, MICH, US), *2022* (DS, F, MICH, US), *2271* (DS); Mpio. Ocozocoautla de Espinosa, SW side of Presa de Malpaso, *Ton 3317* (DS, F, MICH, WIS), *3806* (DS, DUKE, WIS); Mpio. Ocosingo, near Rancho Mumuntik near Ocosingo, *Ton 3472* (DS, DUKE, F); Mpio. Santa Catarina Pantelho, near Rancho Buena Vista near Pantelho, *Ton 3649* (DS, DUKE); Mpio. San Cristóbal de las Casas, Santa Cruz en San Felipe, *Ton & Concepción Mtz. de López 9485* (CAS).—GUERRERO: between Atoyac and Puerto del Gallo, 2.1 km NE of bridge at El Paraíso, *Daniel 5368* (C, CAS, K, MEXU, MICH, MO, US); Distr. Galeana, Río de las Parotas, *Hinton 11181* (GH, K, MICH, UC, US).—HIDLAGO: along Hwy 105 between Zacualtilpán and Acatipa, 0.4 mi S of Acatipa, *Daniel & Bartholomew 5079* (CAS, MICH); Mpio. Tenango de Doria, Las Juntas, 2 kms río arriba de la carr., *Gimate L. 221* (MICH); San Bartolo Tutotepec, *Gimate L. 575* (CAS, MICH).—JALISCO: along hwy in gorge of Río Horcones, ca. 20 km SSW of Puerto Vallarta, *Dieterle 3990* (MICH).—MICHOACÁN: Ostula, *Emrick 46* (F); Distr. Coalcomán, Huizontla, *Hinton et al. 12585* (DS, K, US).—OAXACA: along Hwy 175 between Valle Nacional and Oaxaca, 4.3–6 mi above bridge at Valle Nacional, *Croat & Hannon 65513* (CAS); Chinantla, *Galeotti 510B* (US); Tanetze, *Galeotti 510N* (F, UC, US, W); Distr. Choapan, 4 km S de San Juan del Río, *García M. et al. 2930* (CAS); Mpio. Sta. María Chimalapa, ca. 1 km E de Sta. María por la vereda al Arroyo Sangre, 16°55'N, 94°40'W, *Hernández G. 569* (CAS); Sierra San Pedro Nolasco, Talea, etc., *Jürgensen 407* (K), *877* (BM, K), *894* (BM, K); Distr. Tuxtepec, Chiltepec, *Martínez C. 518* (UC, US), *626* (CAS, UC); Mpio. San Miguel Chimalapa, ca. 38–41 km N de San Pedro Tapanatepec, lat. 16°43'–44'N, long. 94°5'–10'W, *Maya J. 982* (CAS), *1025* (CAS), *1060* (CAS), *1222* (CAS); near Tuxtepec, *Nelson 354* (US); Distr. Mixe, Mpio. Totontepec, Totontepec, 17°15'N, 96°00'W, *Rivera Reyes 258* (CAS); Distr. Juchitán, "Arroyo Pita," 23 km N de Lázaro Cárdenas, brecha a Sta. Maria Chimalapa, *Tenorio L. et al. 3436* (K); Distr. Teotitlán, 8 km NW de Huautla de Jiménez, hacia Teotitlán del Camino, *Torres C. & Antonio M. 6572* (CAS, F); Distr. Mixe, Mpio. Totontepec, 8 km W de Totontepec, camino a Villa Alta, *Torres C. & Ramírez 8519* (CAS); Distr. Choapan, Mpio. San Juan del Río, 7.9 km O de San Juan del Río, carr. a Choapan entrando por Xochiapa (Playa Vicente), *Torres C. et al. 9463* (CAS).—PUEBLA: regio Huauchinango, *Asplund 1054* (F); Mpio. Zapotitlán de Méndez, Atehuiztita, 4.7–5 km SE de Zapotitlán, carr. a Zacapoaxtla, *Campos V. et al. 116* (CAS), *Tenorio L. et al. 12740* (CAS); alrededores de Xicotepec de Juárez, *González Q. 777* (DS, MICH); 2 km N de Xicotepec de Juárez, *Gutiérrez R. 115* (US); Laguna Seca, 20 km NNE de Villa Juárez, Km 34 carr. Méx. Tuxpan, Ver., *Romero R. s.n.* (MICH); Carlos Pacheco, *Salazar s.n.* (US); Mpio. Xicotepec de Juárez, 5 km NE de Xicotepec, carr. a La Ceiba, *Toriz A. et al. 278* (CAS); Mpio. Zapotitlán de Méndez, 6 km NW de Zapotitlán, carr. a Tepango, *Toriz A. et al. 490* (CAS); carr. Cuetzalan San Andres, Cuetzalan, *Zola B. 203* (F); Xochitlán, carr. Zacapoastla–Xochitlán, *Zolá B. 291* (F).—QUERÉTARO: Mpio. Landa, Piedra Blanca, S del Rincón, *González 1417* (MEXU); Mpio. Landa, 1–5 km SE de Neblinas, *Rubio 2286* (CAS).—SAN LUIS POTOSÍ: ca. 5 mi NE of Xilitla, *King 4430* (F, MICH, UC, US); 3 km SW de Aquismón, *Rzedowski 9898* (DS, MICH).—TABASCO: Mpio. Tacotalpa, Rancho Villa Lúz, la cascada, *Ventura A. 21464* (MEXU).—VERACRUZ: Consolapa, Coatepec, *Avendano R. et al. 136* (F, K); Texolo, Xico, *Avendano R. et al. 168* (F); Vallée de Córdova, *Bourgeau 1689* (K, L), *s.n.* (US); Tezonapa, between Córdoba and Tierra Blanca near El Palmar, 15 mi from Tezonapa, *Carlson 1311* (F); Mpio. Alto Lucero, Rancho Nuevo, 19°46'N, 96°41'W, *Castillo C. & Vázquez 1504* (F); Mpio. J. de Ferrer, Cerro de Villa Rica, 19°48'N, 96°46'W, *Castillo C. et al. 1753* (F); Mpio. Huatusco, Km 6, carr.

Huatusco–Xalapa, *Cortina V. 32* (CAS); E. Zapata, Corral Falso, Barranca Sn. Antonio, 19°27'N, 96°45'W, *Gandara & Dorantes 12* (F); between Papantla and Zamora, *Goldman 90* (US); entre Misantla y Yecuatla, *Gómez-Pompa & Riba 136* (F); Córdoba, *Greenman 164* (F); Mpio. Teocelo, Teocelo, *Guerrero C. 1752* (UC); Mpio. Yecuatla, camino a San Cristóbal, 19°52'N, 96°46'W, *Gutiérrez B. 60* (F); Mpio. Yecuatla, Progresso de Juárez, 19°51'N, 96°47'W, *Gutiérrez B. & Paredes L. 26* (F); Fortín, *Kerber 337* (BM, K, MICH); just S of Coatepec, *Langman 3385* (US); Colipa, *Liebmann 10700* (F), *s.n.* (L); Mirador, *Liebmann 10703* (US), *s.n.* (K, L, W); Mirador, *Linden 192* (K, MICH), *Purpus 15335* (F, US); near Caprico, between Xalapa and Huatusco, *Long & Burch 3230* (CAS, DUKE); Atoyac, *Matuda 1405* (MICH), *1410* (MICH), *1413* (MICH, US); Mpio. Chocamán, 1 km N of Chocamán, *Nee 23882* (F); Mpio. Xico, Cascada de Texolo, 3 km SE of Villa Xico (Jico), *Nee & Taylor 26000* (F, MO, UC); Mpio. Tlacotepec de Mejía, 7.5 km E of El Mirador on Totutla–Conejos hwy, *Nee & Taylor 26654* (F); Mpio. Tlapacoyan, along Río Tablazos, 6 km SSW of Tlapacoyan, *Nee et al. 26097* (F); abajo de Plan de las Hayas, *Nevling & Gómez-Pompa 990* (F); Córdoba, *Orcutt 3347* (BM, DS, F, GH, K, MO, US); Mpio. Xalapa, Rancho Guadalupe, Jardín Botánico F. J. Clavijero, *Ortega O–827* (F), *1323* (F); Mpio. Hidalgotitlán, camino Ejido del Moral a 600 m del campamento Hnos. Cedillo, *Ortiz & Martiniano 141* (CAS, F); near Jalapa, *Pringle 8137* (BM, F, ISC, K, L, UC, US); Zacuapan, Barranca de Tenampa, *Purpus 2284* (F, UC, US), *2944* (BM, UC); Zacuapan, *Purpus 3685* (UC), *14234* (F); Barranca near Rancho Viejo, *Purpus 15002B* (UC); Fortín de las Flores, *Romero R. s.n.* (DS, MICH); Mpio. Xalapa, Caida de Agua, Salto de Gato, *Ronzón G. 2* (BM, CAS, F); Cuapichapa, Puente de San Miguel, *Rosas R. 969N* (F); Mpio. Cuauhtlapan, Rincón Barrientos, *Rosas R. 1085* (CAS, F, U); Barranca de San Miguel, Km 17 carr. Orizaba–Córdoba, *Rosas R. 1146* (F); near Huatusco, *von Rozynski 758* (F); Jalapa, *C. Smith 1699* (MICH); Mpio. Teocelo, Cascada Texolo, 8 km SO de Coatepec, *S. Smith 6083* (F); Mpio. Zozocolco, 2.5 km N de Zozocolco, *Tenorio L. et al. 8582* (CAS); Mpio. Hidalgotitlán, brecha Hnos. Cedillo–Agustin Malgar, 17°16'N, 94°37'W, *B. Vázquez 510* (F); Teocelo, Barranca de Teocelo, *V. Vázquez T. 95* (F, UC), *Zola B. 137* (F); Nacaxtla por la carr. rumbo a Zomajapan, Zongolica, 18°40'N, 96°59'W, *V. Vázquez T. 183* (F); Zoncuantla, *Velázquez L. VL–11* (F); Tlazololapan, Tequila, *Velázquez L. 121* (F, UC), *362* (F); Mpio. Totutla, Mata Oscura, *Ventura A. 4738* (CAS, MICH); Mpio. San Juan–Coscomatepec, El Encino, *Ventura A. 4788* (CAS, MICH); Mpio. Misantla, Cruz alta, *Ventura A. 5098* (CAS, MICH); Mpio. Misantla, Km 9, *Ventura A. 8118* (MICH); Mpio. Xalapa, Mártires de Chicago, *Ventura A. 9491* (MICH); Mpio. San Juan Coscomatepec, Baranquilla, *Ventura A. 16924* (WIS); vic. of Río Tonto, Ejido de Almilinga, 6 km W of Campo Experimental de Hule El Palmar, Zongolica, *Vera S. 2825* (MICH, US); Mpio. Minatitlán, orilla del Río Grande, 15.7 km E de La Laguna, *Wendt et al. 2902* (CAS, F, L, MICH); Fortuño, Coatzacoalcos River, *Williams 8610* (F, US).

**Odontonema cuspidatum** (Nees) Kuntze, Revis. gen. pl. 2: 494. 1891. *Thyrsacanthus cuspidatus* Nees in A. DC., Prodr. 11: 323. 1847.—TYPE: MEXICO. Oaxaca: Sierra S. Pedro Nolasco, Talea, etc., *Jürgensen 985* (lectotype, here designated: K!; isolectotype: BM!).

Shrub to 5 m tall, young stems quadrate to quadrate-sulcate, sparsely pubescent with antrorse (to erect to flexuose) eglandular trichomes 0.1–0.5 mm long, trichomes often ± concentrated in 2 lines, soon glabrate. Leaves petiolate, petioles to 30 mm long, blades ovate-elliptic to elliptic to obovate-elliptic, 39–310 mm long, 15–130 mm wide, 1.7–5.6 times longer than wide, acuminate to falcate at apex, acute to attenuate at base, surfaces pubescent with cauline-type trichomes (especially along midvein on abaxial surface) or glabrate. Inflorescence of loose to dense, terminal, pedunculate, often basally branched dichasiate (racemes to) thyrses to 500 mm long, 15–170 mm in diameter (including branches) near midpoint of fertile portion, rachis pubescent with erect to flexuose-antrorse eglandular trichomes 0.05–0.3 (–0.5) mm long; dichasia opposite at nodes, 1–3- or more-flowered, (subsessile to) pedunculate (at least some dichasia in an inflorescence clearly pedunculate), peduncles to 25 mm long, pubescent like rachis. Bracts lance-subulate to subulate to triangular, those near middle of inflorescence 1.5–2.5 (–6) mm long, 0.7–1.5 mm wide, abaxial surface pubescent like rachis or nearly glabrous. Bracteoles and secondary bracteoles triangular to triangular-subulate, 0.7–1.5 mm long, 0.5–0.8 mm wide, abaxial surface pubescent like bracts or nearly

glabrous. Flowers pedicellate, pedicels often with a reddish cast, 2.5–15 mm long, pubescent like rachis. Calyx often with a reddish cast, 2–5.5 mm long, tube 0.8–1.1 mm long, lobes lanceolate to triangular, 1–5 mm long, 0.8–1.3 mm wide, abaxially pubescent like bracts or nearly glabrous. Corolla red, (15–) 21–35 mm long, externally glabrous (although margins of lobes ciliolate), tube 12–30 mm long, barely or gradually expanded distally into a ± distinct throat, throat 5–10 mm long, 2.5–4 mm in diameter (measured flat) near midpoint, upper lip 2–5 mm long, lobes rounded to acute, 1.5–3.5 mm long, 2.5–3 mm wide, lower lip 2.5–6 mm long, lobes ovate to subcircular, 2.5–6 mm long, 1.5–3.5 mm wide. Thrum stamens 7–9 mm long, pin stamens 4–5 mm long, thecae 2.3–3.5 mm long; pollen 4-colporate; staminodes 1 mm long. Thrum style 4–12 mm long, pin style 15–21 mm long, the style nearly glabrous or pubescent with eglandular trichomes, trichomes disposed ± throughout or restricted to proximal portion; stigma funnelform or bilobed, lobes equal, 0.2–0.3 mm long. Capsule 16–27 mm long, glabrous, stipe 7–11 mm long, head 9–16 mm long. Seeds subcordate to subrectangular in outline, 2.9–4.2 mm long, 2.2–3.7 mm wide, surface rugose to tuberculate. Chromosome number unknown.

Phenology. Flowering and fruiting throughout the year.

Distribution. Mexico (Chiapas, Hidalgo fide Baum, Morelos, Oaxaca, Querétaro, San Luis Potosí, Tabasco, Veracruz; Fig. 4) and West Indies; in lowland rain forests, montane rain forests, mesophytic montane forests, pine-oak forests, and cloud forests; sea level to 1950 meters. The species is commonly cultivated in the American tropics where it sometimes persists or escapes. Cultivated material has been seen from Mexico and El Salvador. Plants are known as escapes in Lee Co. and Highland Co., Florida, USA. Much of the material from the West Indies is reported as cultivated or persisting from cultivation. It is possible that the species is not native there, and it is likely that the species is not native to many of the Mexican states noted above.

Local names. "Flor de chuparrosa" (*Ortiz & Martiniano 183*), "flor de chupa miel" (*Juan 145*).

Uses. *Cházaro & Robles 3199* notes that plants are cultivated for medicinal and ornamental uses.

The lectotype is chosen from among the three syntypes (i.e., *Linden 180*, *Jürgensen 894*, and *Jürgensen 985*) listed by Nees in Hooker's herbarium. One of the syntypes (*Jürgensen 894*) represents *O. callistachyum*. *Jürgensen 985* is the more complete of the remaining syntypes. Baum (1982a) noted that *Linden 180* at G was the lectotype. Her choice, if considered as published, would be in error, however, because she chose an isosyntype rather than a syntype.

*Odontonema cuspidatum* resembles *O. rubrum* (Vahl) Kuntze of Panama and northern South America by its opposite, pedunculate dichasia and short, mostly erect, eglandular trichomes of the rachis. These two species can be distinguished by the following couplet:

Corolla externally pubescent with eglandular trichomes, tube abruptly expanded near the midpoint into a prominent throat, bent at point of expansion, upper lip 6–13 mm long; pollen 3-aperturate; Panama, Colombia, Venezuela. *O. rubrum*.

Corolla externally glabrous, tube barely or gradually expanded distally into a ± distinct throat, straight, upper lip 2–5 mm long; pollen 4-aperturate; Mexico and West Indies. *O. cuspidatum*.

Additional Specimens Examined. **Mexico.** Chiapas: Mpio. Pichucalco, 11 km ENE of Pichucalco, *Breedlove 45893* (CAS); Selva Negra above Rayón, *Breedlove 71454* (CAS, MEXU, MICH); Mpio. Rayón, Selva Negra 10 km above Rayón Mezcalapa along rd to Jitotol, *Breedlove & Dressler 29801* (DS, MEXU), *Breedlove & Smith 32417* (DS); Mpio. Huixtla, sitios or along streets of Huixtla,

*Breedlove & McClintock 23784* (DS); Mpio. Pichucalco, E bank of Río Coamapa above Rancheria Coamapa, *Gilly & Hernández X. 135* (MEXU, MICH); along Río Pichucalco, 3 km NE of Pichucalco toward Villahermosa, 17°32'N, 93°04'W, *Marcks & Marcks 895* (WIS); Mt. Ovando, *Matuda 149* (F, MEXU, MICH, US); F. Las Nubes, *Miranda 1719* (MEXU); between Tumbalá and El Salto, *Nelson 3376* (US); inter Ixtacomitán et La Trinidad, *Rovirosa 880* (K); 40 km S of Sureste on rd to Mal Paso, *Roe et al. 1393* (MICH, WIS); Mpio. Rayón, 9 mi NW of Pueblo Nuevo Solistahuacán along rd between Rincón Chamula and Rayón, 17°30'N, 93°40'W, *Zuill 736* (DS).—Guerrero: La Soledad, *Langlassé 974* (F, K).—Morelos: near Cuernavaca, *Halbinger 42* (GH), *Halbinger & Reko 301* (US). Oaxaca: 29.8 km S of Valle Nacional, *Bartholomew et al. 3341* (CAS); 70–75 km S of Tuxtepec on rd to Oaxaca, *Breedlove & Almeda 56730* (CAS); along Hwy 175 through Sierra de Juárez between Tuxtepec and Oaxaca, 18 mi S of bridge at Valle Nacional, *Croat 47965* (BM); along Hwy 175 between Valle Nacional and Oaxaca, 17–19 mi above bridge at Valle Nacional, *Croat & Hannon 65572* (CAS); Mpio. Sta. María Chimalapa, ca. 8–10 km N de Sta. María, 17°00'N, 94°41'W, *Hernández G. 2089* (CAS); Mpio. Sta. María Chimalapa, Arroyo Sangre, ca. 1–2 km E de Sta. María, 16°54'N, 94°40'W, *Hernández G. 233* (CAS), *2592* (CAS); Sierra San Pedro Nolasco, Talea, etc., *Jürgensen 649* (K); Distr. Ixtlán, Mpio. Comaltepec, La Esperanza, *López L. 404* (CAS), *591* (CAS); Ixtlán, Vista Hermosa, Comaltepec, *MacDougall s.n.* (F); Sierra Juárez, entre Vista Hermosa a Comaltepec, Km 82 entre Tuxtepec a Oaxaca, *Martínez C. 238* (F, US); Sierra Juárez, entre Vista Hermosa a Comaltepec, Km 136 entre Tuxtepec a Oaxaca, *Martínez C. 310* (F, US); Distr. Choapam, Yaveo, near Arroyo del Perrico, *Mexia 9150* (B, CAS, F, K, U, UC, US); Distr. Mixe, Mpio. Totontepec, rumbo Villa alta, 16 km O de Totontepec, *Ramírez G. & Ramírez C. 543* (CAS); Distr. Mixe, Mpio. Totontepec, Totontepec, 17°15'N, 96°00'W, *Rivera R. 1259* (CAS); Mpio. Juquila, 4 km S de Lachao, Km 183 carr. Oaxaca–Puerto Escondido, *Rzedowski 19546* (MICH); 39 km S de Valle Nacional, sobre la carretera a Oaxaca, *Rzedowski 33777* (WIS); Distr. Ixtlán, Mpio. Comaltepec, 13 km SO de La Esperanza, carr. Tuxtepec Oaxaca, *Torres C. & Campos 10922* (CAS); Distr. Mixe, Mpio. Totontepec, 10.5 km N de Totontepec, carr. a Choapan, 17°17'N, 95°59'W, *Torres C. & Cortes 10405* (CAS); Distr. Ixtlán, Mpio. Comaltepec, 2 km SO de La Esperanza, carr. Tuxtepec–Oaxaca, *Torres C. & Cortes A. 11677* (CAS); Distr. Juchitán, Chichihua, camino a Sta. María Chimalapa, *Torres C. & Martínez 5988* (CAS); Distr. Ixtlán, Mpio. Comaltepec, 5 km O de La Esperanza, carr. Tuxtepec - Oaxaca, *Torres C. & Martínez S. 11294* (CAS); Distr. Tuxtepec, Metates, carr. Tuxtepec–Oaxaca, *Torres C. et al. 7799* (CAS); Distr. Ixtlán, 21.4 km S de Valle Nacional sobre carretera a Oaxaca, *Wendt et al. 2261* (CAS); locality and collector unknown, "Oaxaca 1842", "franco," (W).—Querétaro: Mpio. Landa, 1 km NO de San Onofre, *Rubio 1888* (CAS); Mpio. Landa, Rancho Nuevo, 1–2 km SE de San Onofre, *Rubio 802* (CAS), *892* (CAS); Mpio. Landa, 10 km SE de Agua Zarca, sobre camino a Pisaflores, *Rzedowski 45169* (MEXU).—San Luis Potosí: Mpio. San Antonio, Tokoy, *Alcorn 3328* (MEXU).—Tabasco: Teapa, *Linden 180* (G, K); Mpio. Teapa, Puyacatengo, *Ventura A. 20601* (MEXU).—Veracruz: Sierra de Tuxtla, Cerro Tuxtla, 3 mi WSW of Santiago Tuxtla, *Anderle 42* (US); NW de Santiago Tuxtla, *Beaman 6078* (F, U); Catemaco–Sontecomapan rd, 8.5 km SW of Sontecomapan, *Breckon & Breckon 2023* (F, MEXU, WIS); Catemaco, *Boege 3199* (MEXU); Mpio. Soteapan, faldas del Cerro el Platanillo, Sierra de Santa Martha, *Calzada 5091* (F); Presa del canala de Riego, 2 km antes de la Barranca de Tlacuitlapa, 19°23'N, 96°48'W, *Castillo C. & Tapia 802* (F); Mpio. San Andrés Tuxtla, Est. Biol. Tropical Los Tuxtlas, *Cedillo T. 2644* (MEXU), *Ibarra M. 447* (MEXU), *787* (MEXU), *Ibarra M. & Sinaca C. 1922* (MEXU), *Martínez C. 1724* (CAS, F, MEXU, MICH, US), *2178* (BM, F, K, MEXU); Mpio. San Andrés Tuxtla, 20 km N de San Andrés Tuxtla, *Cedillo T. 3457* (CAS); Mpio. Tatahuicapa, entre Piedra Pasada & Guadalupe Victoria, *Cházaro 3257* (MICH, WIS); Mpio. Las Choapas, poblado Abasal, orillas del Río Tonala, *Cházaro & Robles 3199* (WIS); Mpio. Catemaco, 4.5 km W of Sontecomapan on rd to Catemaco, *Cowan et al. 5787* (CAS); Mpio. San Andrés Tuxtla, Est. Biol. Tropical Los Tuxtlas N of San Andrés Tuxtla between Sontecomapan and Montepio, *Croat & Hannon 63132* (CAS); region of San Andrés Tuxtla, near Tapalapan NW of Santiago Tuxtla, *Dressler & Jones 41* (BM, MICH, UC, US); Fortín, *Fisher 35508* (F, US); Mpio. Las Choapas, Las Cruces, *Gómez-Pompa & Nevling 1514* (F); camino Bastonal a Santa Martha, 18°24'N, 94°57'W, *Gómez-Pompa et al. 5403* (F); 35 km NE of Catemaco, *den Held & van Rhijn HC 13* (U); Playa Escondida, near Sontecomapan, ca. 18°34'N, 95°06'W, *Holstein & Armbruster 20367* (MEXU); Volcán San Martín, Los Tuxtlas, *Houck 37* (MICH); Mpio. Hidalgotitlán, Campamento H. Cedillo a 9 km a La Gloria, *Juan 145* (CAS, F); región de Los Tuxtlas, hacia Laguna Escondida, *Lot 965* (F, MEXU); Playa de Vaca, *Martínez C. 1517* (CAS, F, MICH); Mpio. Catemaco, 7 km NE of Sontecomapan, *Nee 22596* (F); Mpio. Pajapan, 5 km NW of Pajapan, *Nee & Calzada 22755* (F, MO); Mpio. Soteapan, 13 km E of Tebanca (13 km E of E side of Lago Catemaco), *Nee & Hansen 18790* (F); Mpio. Las Choapas, along Río Grande near main gravel rd of Uxpanapa region, 17°16'N, 94°22'W, *Nee & Taylor 29861* (F); Mpio. Soteapan, cerca del Volcán de Santa Martha (en

las Faldas), 18°25'N, 96°56'W, *Ortega O. et al. 1129* (F); Mpio. Hidalgotitlán, Campamento Hnos. Cedillo a 9 km por El Río de Los Cedros rumbo SO, *Ortiz & Martiniano 183* (BM, CAS, F, L); Córdoba, *Plunkett 155* (F); ca. 1 km S of Monte Pie, ca. 18°38'N, 95°05'W, *Poole et al. 1435* (MEXU); Mpio. Catemaco, "Playa Escondida," 10 km N of Sontecomapan, *Schatz & Nee 206* (F, MEXU); Mpio. Catemaco, 8 km (air) NE of Catemaco, *Schatz & Nee 241* (F, US); Laguna Escondida, 5 km de La Est. de Biol. de Los Tuxtlas, *Soto & Horvitz 25* (F, MEXU); Salto de Syipantla, 12 km W de Catemaco, *Torres C. & Hernández 6445* (CAS); Mpio. Hidalgotitlán, Río Soloxuchil SW del Campamento Hnos. Cedillo, 17°16'N, 94°37'W, *B. Vázquez 309* (F); Mpio. Jesús Carranza, 2 km N del Poblado 2, Ejido F. J. Mina, 17°16'N, 94°40'W, *M. Vázquez T. et al. V–2463* (CAS); Mpio. San Pedro Soteapan, 3 km N de Santa Martha, 18°25'N, 94°56'W, *F. Vazaquz B. & Hernández 42* (F); Mpio. Catemaco, Chochoví, *Ventura A. 5862* (CAS); Mpio. Hidalgotitlán, desde el Poblado 6 al S por la brecha y la vereda, 17°15'N, 94°30"W, *Wendt et al. 2802* (CAS).—State Unknown: without locality, as "Justicia tubulosa No. 43," *Sessé et al. 297* (F).

**Odontonema glaberrimum** (M. E. Jones) V. M. Baum, Brittonia 34: 427. 1982.
*Anisacanthus glaberrimus* M. E. Jones, Contr. W. Bot. 15: 151. 1927.—TYPE: MEXICO. Nayarit: El Tigre Mina, Acaponeta, 1 Mar 1927, *M. E. Jones 22976* (holotype: POM!).

Shrub to small tree to 3 m tall, young stems quadrate to quadrate-sulcate, glabrous or ± evenly puberulent with flexuose to antrorse eglandular trichomes 0.05–0.2 mm long. Leaves subsessile to petiolate, petioles to 11 mm long, blades ovate to elliptic to obovate-elliptic, 25–200 mm long, 11–78 mm wide, 1.7–2.6 times longer than wide, acute to acuminate at apex, acute to attenuate at base, surfaces glabrous or pubescent with cauline-type trichomes mostly restricted to major veins, or ± evenly pubescent with coarse, flexuose-antrorse eglandular trichomes to 0.6 mm long. Inflorescence of loose to dense, terminal (or sometimes axillary), sessile to pedunculate, unbranched or basally branched dichasiate racemes (or thyrses) to 200 mm long, 10–20 mm in diameter near midpoint of fertile portion, rachis glabrous or evenly pubescent with flexuose to antrorse eglandular trichomes 0.05–0.5 mm long; dichasia opposite at nodes, sessile or subsessile (peduncles to 1 mm long), 1–3- or more-flowered. Bracts often subfoliose proximally, soon becoming subulate to triangular, bracts near middle of inflorescence 1.5–7.5 mm long, 0.8–1.2 mm wide, abaxial surface glabrous or pubescent like rachis. Bracteoles and secondary bracteoles subulate to triangular, 1–4 mm long, 0.6–1.2 mm wide, abaxial surface glabrous or pubescent like rachis. Flowers pedicellate, pedicels 3–13 mm long, pubescent like rachis or sometimes nearly glabrous even when rachis is pubescent. Calyx 2.5–5 mm long, tube 0.5–1 mm long, lobes subulate, 2–4.5 mm long, 0.4–0.8 mm wide, abaxially pubescent like rachis or glabrous. Corolla red, 16–32 mm long, externally glabrous, tube 10–17 mm long, expanded distally into a distinct throat, throat 3–8 mm long, 3–6 mm in diameter (measured flat) near midpoint, upper lip 6–13 mm long, lobes rounded to acute, 2–3.5 mm long, 1.7–2.5 mm wide, lower lip 6.5–14 mm long, lobes linear-elliptic, 5–12 mm long, 2–4 mm wide. Thrum stamens 12–14 mm long, pin stamens sometimes partially exserted from tube, 4–6.5 mm long, thecae 2–3 mm long; pollen 3-colporate; staminodes 1–1.5 mm long. Thrum style 8–12 mm long, pin style 15–21 mm long, the style glabrous or with sparse eglandular trichomes proximally or pubescent ± throughout; stigma 0.2–0.5 mm long, lobes barely or clearly evident, equal. Capsule 18.5–27 mm long, glabrous, stipe 8–12.5 mm long, head 10.5–14 mm long. Seeds subcordate in outline, 5–6 mm long, 4.5–4.8 mm wide, surface smooth. Chromosome number unknown.

Phenology. Flowering and fruiting January–April.

Distribution. Mexico (Chiapas, Durango, Nayarit, Sinaloa; Fig. 4) and Guatemala; in tropical deciduous forests and tropical subdeciduous forests; 100–1300 m.

This species exhibits a distributional range with two apparently disjunct outposts in northwestern Mexico and Chiapas–Guatemala. Baum (1982a) included Jalisco and Michoacán within the distributional range of this species based on specimens here treated as *O. auriculatum*. Interestingly, the distribution of *O. auriculatum* (Fig. 5) occupies the gap between the disjunct outposts of *O. glaberrimum*. These species are very similar and appear to differ primarily by the sessile and auriculate leaves of the former. Plants lacking leaves can be difficult to distinguish, but the difference in rachis pubescence (which is usually evident) is often helpful then. It is perhaps doubtful that *O. glaberrimum* is significantly distinct from *O. auriculatum*. *Flores F. & Ruenes 2042* contains both species which undoubtedly grew together. All other collections appear to represent either one or the other species as delimited here.

Additional Specimens Examined. **Mexico.** Chiapas: Mpio. Arriaga, 6 km N of Arriaga, *Breedlove 24434* (DS); Mpio. Arriaga, 13 km N of Arriaga along Mex. Hwy 195, *Breedlove & Thorne 30601* (DS, MICH), *Breedlove & McClintock 23724* (DS); Mpio. Cintalapa de Figueroa, 5 km W of Rizo de Oro along Mex. Hwy 190, *Breedlove 49628* (CAS); Mpio. Cintalapa, 3 km W of Rizo de Oro, *Breedlove 66967* (CAS); along Hwy 190 ca. 2 mi E of Oaxaca border, *Croat 46278* (CAS, F). —Durango: side canyons of barranca of Río Tamazula, between Agua Caliente and La Bajada, *Breedlove 24478* (CAS); canyons of Río Tamazula between La Bajada and La Junta, *Breedlove 24506* (CAS, US); Sianorí, *Ortega 1924* (US). —Nayarit: Microondas Santa Barbara, 3–3.8 mi E Hwy 15 between Sinaloa border and Acaponeta, *Daniel & Bartholomew 4727* (C, CAS, K, MEXU, MICH, MO, US); Mpio. Compostela, 4 km NE de Valle de Banderas, 20°50'N, 105°12'W, *Flores F. & Ruenes 2042* (MICH); Mpio. Xalisco, al E de Palapita, camino a Los Cuarenta, *González 693* (MEXU); Tiger Mine, Acaponeta, *M. Jones 23266* (POM); 6–12 km NE of Miramar, rd to Jalcocotán, *McVaugh 23562* (MICH); 7 km SE del Rancho El Rojo (7 km E de Las Varas, camino a Compostela) por el camino viejo de Mazatán a Las Varas, 21°11'N, 105°06'W, *Téllez V. & Flores F. 11884* (MEXU, MICH).—Sinaloa: Mpio. Sinaloa y Vela, Sierra Surutato, mouth of Cañón de Tarahumares along rd from Morcorito to Surutato, *Breedlove 19029* (CAS, F, US); ca. 30 mi E of Culiacán along rd between Presa López Mateos and Tamazula, Durango, *Breedlove 24467* (CAS, MEXU, MICH); Cerro Colorado, *Gentry 5482* (DS, MEXU, MICH, RSA, US); Distr. Badiraguato, Arroyo de Carrisal, *Gentry 5801* (DS, MEXU, MICH, RSA, US); Mpio. Culiacán, Tierras Blancas, 2 km N de El Rincón, Brecha a Tamazula, 24°51'N, 107°00'W, *Tenorio L. et al. 8297* (CAS); Mpio. Rosario, 3.5 km N de Palmarito, 23°02'N, 105°41'W, *Tenorio L. et al. 8524* (MEXU, RSA).

**Odontonema glabrum** Brandegee, Univ. Calif. Publ. Bot. 6: 195. 1915.—Type: Mexico. Chiapas: Finca Irlanda, May–June 1914, *Purpus 7286* (holotype: UC!; isotypes: BM! DS!).

*Odontonema galbanum* Leonard, J. Wash. Acad. Sci. 33: 72. 1943.—Type: Guatemala. Escuintla: near Barranca Honda, above Las Lajas, ca. 1200 m, 31 Jan 1939, *Standley 63875* (holotype: US!; isotype: F!).

Perennial herb or shrub (sometimes epiphytic) to 2.5 m tall, young stems subterete to subquadrate, glabrous. Leaves petiolate, petioles to 10 (–23) mm long, blades ovate to narrowly elliptic to obovate-elliptic, 40–275 mm long, 16–85 mm wide, 2.5–5.2 times longer than wide, acuminate to falcate at apex, rounded to acute to attenuate at base, surfaces and margin glabrous. Inflorescence of open, terminal (or sometimes axillary), pedunculate, unbranched or basally branched thyrses to 360 mm long, 15–55 (–100) mm in diameter (including branches) near midthyrse, rachis glabrous; dichasia opposite at nodes, 3-flowered (distally) or more-flowered (proximally), pedunculate, peduncles (1.5–) 4–34 mm long, glabrous. Bracts petiolate and narrowly elliptic to oblanceolate proximally, soon

becoming sessile and subulate to triangular-subulate, those near middle of inflorescence 2.5–7 mm long, 0.7–1 mm wide, abaxial surface glabrous. Bracteoles and secondary bracteoles subulate, 1–5 mm long, 0.4–0.7 mm wide, abaxial surface glabrous. Flowers pedicellate, pedicels 3–12 mm long, glabrous, lateral flowers of dichasia borne on secondary peduncles. Calyx 2–5 mm long, tube 0.5–1 mm long, lobes lanceolate to subulate, 1.7–4.5 mm long, 0.4–0.9 mm wide, abaxially glabrous. Corolla yellow, 22–32 mm long, externally glabrous (although margins of lobes ciliolate), tube 18–29 mm long, expanded distally into a distinct throat, throat 11–15 mm long, 3.5–5.3 mm in diameter (measured flat) near midpoint, upper lip 3–5 mm long, lobes rounded, 1–2.5 mm long, 1.8–3 mm wide, lower lip 2.8–5 mm long, lobes elliptic, 2.8–5 mm long, 2–4.2 mm wide. Thrum stamens 14 mm long, pin stamens 8–11 mm long, thecae 2.6–3.1 mm long; pollen 3-colporate; staminodes 1 mm long. Thrum style 12–16 mm long, pin style 22–26 mm long, the style glabrous; stigma bilobed, lobes equal, 0.2–1 mm long. Capsule 17–21 mm long, glabrous, stipe 8–10 mm long, head 9–11 mm long. Seeds subcircular to subelliptic in outline, 3–4.2 mm long, 2.6–3.3 mm wide, surface rugose to tuberculate. Chromosome number unknown.

Phenology. Flowering: December–August; fruiting: December–June.

Distribution. Mexico (Chiapas; Fig. 6) and Guatemala; in tropical deciduous forests, evergreen seasonal forests, pine-oak woodlands, and montane rain forests; 100 to 1600 m.

Local names. "Cola de Ardilla," "monte o pluma de oro" (*Boege 1074*).

The holotype of *O. galbanum* from Guatemala has young stems sparsely pubescent in lines with flexuose to antrorse eglandular trichomes. In other respects it agrees with this species.

*Odontonema glabrum* resembles *O. hondurense* from Belize, Guatemala, and Honduras by its open inflorescence, yellow corollas, and opposite bracts. These two species can be distinguished by the following couplet:

Young stems puberulent with eglandular trichomes to 0.05 mm long; inflorescence a panicle of dichasiate racemes, rachis puberulent like stems, dichasia sessile to subsessile (i.e., peduncles to 0.5 mm long); corollas 14–22 mm long, externally puberulent with glandular and eglandular trichomes. *O. hondurense.*

Young stems glabrous; inflorescence an unbranched or basally branched thyrse, rachis glabrous, dichasia pedunculate, peduncles (1.5–) 4–34 mm long; corollas 22–32 mm long, externally glabrous. *O. glabrum.*

Additional Specimens Examined. **Mexico.** Chiapas: Huixtla, Finca Sta. Anita, *Boege 1074* (MEXU); Mpio. Angel Albino Corzo, NE slope of Cerro Venado above Finca Cuxtepeque, *Breedlove 48650* (CAS, MEXU), *Breedlove & M. Bourell 67668* (CAS, K, MEXU, MICH, US), *Breedlove & Almeda 56923* (CAS, F, US); Mpio. Angel Albino Corzo, slopes of Río Cuxtepec below Finca Cuxtepec, *Breedlove 50735* (CAS, MEXU, US); Mpio. Angel Albino Corzo, between Finca Cuxtepeque and Finca Cabañas, *Breedlove & Bourell 67391* (BR, CAS, ENCB, MEXU, MO); Mpio. Arriaga, 13 km N of Arriaga along Mex. Hwy 195, *Breedlove & Thorne 30621* (DS, DUKE, F, MEXU, MICH); along rd between Escuintla and Monte Ovando, 2.8 km NW of Turquiz, *Croat 47484* (CAS); El Triunfo Reserve, *Heath & Long MA51* (MEXU); Mpio. Motozintla, El Rosario–Tolimán rd between Huixtla and Motozintla, 15°18'N, 92°23'W, *Heath & Long 2113* (MEXU); Mpio. El Edén, El Edén, *López 1347* (ENCB); Mpio. Unión Juárez, Volcán Tacaná, 8 km SW de Unión Juárez, camino a Cacahoatán, *Martínez S. et al. 19848* (MEXU); Mpio. Tuzantan, 15 km NE de Huixtla, camino a Ejido J. M. Morelos, *Martínez S. et al. 19960* (CAS, MEXU); Escuintla, *Matuda 170* (MEXU, MICH, US); Mt. Tacaná, *Matuda 2470* (MICH); Cascada, Siltepec, *Matuda 5174* (F, MEXU, US); Cintalapa, Escuintla, *Matuda 17430* (F, MEXU); Acacoyagua, *Matuda 17434* (F, K, MEXU), *17629* (F, MEXU); Corcega, Pueblo Nuevo, Com., *Matuda 17657* (F, MEXU); F. Las Nubes, *Miranda 1691* (MEXU); Barr. Aguas Calientes, *Miranda 1729* (MEXU); Cerro del Boquerón, *Purpus 6845* (UC), *7208* (MO, UC, US); Finca S. Antonio, *Quarles van Ufford 118* (U); Mpio. La Concordia, camino a

Custepeques, entre Finca La Perla y Finca Las Cabañas, *Rodríguez G. 122* (CAS); Mpio. Angel Albino Corzo, along Río Cuztepeques near Finca Cuztepeques, *Ton 3842* (DS, F, MICH, US); Mpio. Tapachula, Cantón Manga de Clavo, *Ventura & López 1137* (BM); Mpio. Tuxtla Chico, La Escondida, *Ventura & López 3257* (MEXU).

**Odontonema mortonii** V. M. Baum, Brittonia 34: 430. 1982.—TYPE: MEXICO. Oaxaca: vicinity of Cafetal Concordia, 400–650 m, 1–15 Apr 1933, *Morton & Makrinius 2356* (holotype: US!; isotypes: A! F! K! NY).

Shrub to 2 m tall, young stems subterete to quadrate-sulcate, glabrous or rarely with some internodes sparsely bifariously pubescent with antrorse eglandular trichomes 0.1–0.2 mm long. Leaves subsessile to petiolate, petioles to 17 mm long, blades elliptic to obovate, 80–222 mm long, 32–71 mm wide, (1.8–) 2.8–4.2 times longer than wide, acuminate to subfalcate at apex, acute to attenuate at base, surfaces glabrous, margin entire to crenate. Inflorescence of ± loose, terminal (or sometimes borne in axils of distal leaves), pedunculate, unbranched (or basally branched) dichasiate racemes (or panicles of racemes) to 300 mm long, 9–90 mm in diameter near midpoint of fertile portion, rachis glabrous; dichasia opposite (to subopposite) at nodes, 3–many-flowered, sessile (or subsessile, i.e., borne on peduncles to 0.5 mm long). Bracts near middle of inflorescence triangular to subulate, 1.5–4 mm long, 0.6–1.2 mm wide, abaxial surface glabrous (margin ciliate), proximal bracts sometimes linear and longer. Bracteoles triangular to subulate, 1–3.3 mm long, 0.5–1 mm wide, abaxial surface glabrous, secondary bracteoles similar to bracteoles or often smaller. Flowers pedicellate, pedicels 1.5–7 mm long, glabrous, lateral flowers of dichasia not borne on secondary peduncles. Calyx 2–3.5 mm long, tube 0.3–0.8 mm long, lobes subulate, 1.5–3 mm long, 0.5–0.8 mm wide, abaxially glabrous. Corolla yellow, 23–30 mm long, externally glabrous (margins of lobes ciliolate), tube 18–25 mm long, expanded distally into a throat, throat 11–15 mm long, 4–5 mm in diameter (measured flat) near midpoint, upper lip 3–5 mm long, lobes elliptic, 1.5–2 mm long, 1–1.7 mm wide, lower lip 4–5.8 mm long, lobes ovate, 3.5–5.5 mm long, 2–3 mm wide. Thrum stamens 14–16 mm long, pin stamens 9–10 mm long, thecae 2.3–2.5 mm long; pollen 3-colporate; staminodes 1 mm long. Thrum style 10–15 mm long, pin style 19–24 mm long, the style glabrous; stigma 0.1–0.2 mm long, lobes barely distinct, unequal. Capsule 13–15 mm long, glabrous, stipe 4–6.5 mm long, head 7–9 mm long. Seeds 2.7 mm long, 2 mm wide, subelliptic in outline, surface rugose. Chromosome number unknown.

Phenology. Flowering and fruiting February–April.

Distribution. Southern Mexico (Guerrero, Oaxaca; Fig. 6); in mesophytic forests on the Pacific slope; 400–540 m.

ADDITIONAL SPECIMENS EXAMINED. **Mexico.** GUERRERO: "Sierra Madre," [Pacific slope from Coyuquilla along trail toward Coyuca de Catlán, fide McVaugh 1951], *Langlassé 839* (K, MICH).—OAXACA: river below Candelaria Loxicha, *Alexander 444* (MICH); Mpio. Candelaria Loxicha, "El Pacifico," 4 km N de Candelaria Loxicha, carr. a Miahuatlán, 15°56'N, 96°28'W, *Campos & Reyes 1439* (CAS, MEXU); Distr. Pochutla, Pilas, vicinity of Concordia, *Makrinius 731* (US).

**Odontonema tubaeforme** (Bertol.) Kuntze, Revis. gen. pl. 2: 494. 1891. *Justicia tubaeformis* Bertol., Novi Comment. Acad. Sci. Inst. Bononiensis 4: 405. 1840. *Thyrsacanthus tubaeformis* (Bertol.) Nees in A. DC., Prodr. 11: 324. 1847.—TYPE: GUATEMALA. Escuintla: Escuintla, 1836, *Velásquez s.n.* (holotype: BOLO, microfiche!).

*Thyrsacanthus strictus* Nees in A. DC., Prodr. 11: 324. 1847. *Odontonema strictum* (Nees) Kuntze, Revis. gen. pl. 2: 494. 1891.—TYPE: HONDURAS. Without locality or date, *Armstrong s.n.* (holotype: K!).

*Eranthemum coccineum* Lem., Fl. Serres Jard. Eur. 3: no. 240, t. 8. 1847, non *Odontonema coccineum* Leonard, 1958. *Thyrsacanthus lemairianus* Nees in A. DC., Prodr. 11: 729. 1847, nom. superfl.—TYPE: based on cultivated materials provided by Jacob-Makoy of Liége from an unknown source; plants apparently arrived on the European Continent via England under "Aphelandra sp. nov."; specimens are not known.

*Thyrsacanthus pantasmensis* Oerst., Vidensk. Meddel. Dansk Naturhist. Foren. Kjøbenhavn 1854: 144. 1855. *Odontonema pantasmense* (Oerst.) Kuntze, Revis. gen. pl. 2: 494. 1891.—TYPE: NICARAGUA. "Skyggefulde Skov paa Bjerget Pantasmo i den nordlige Deel af Segovia," ca. 4000 ft, Jan, *Oersted 10709* (holotype: C, photos: F! US!).

*Thyrsacanthus longifolius* Oerst., Vidensk. Meddel. Dansk Naturhist. Foren. Kjøbenhavn 1854: 145. 1855. *Odontonema longifolium* (Oerst.) Kuntze, Revis. gen. pl. 2: 494. 1891.—TYPE: "i Naerheden af Nicaraguasö ved Tortuga," Mar 1847, *Oersted 10708* (holotype: C, photos: F! US!).

*Thyrsacanthus flagellum* Oerst., Vidensk. Meddel. Dansk Naturhist. Foren. Kjøbenhavn 1854: 146. 1855. *Odontonema flagellum* (Oerst.) Kuntze, Revis. gen. pl. 2: 494. 1891.—TYPE: COSTA RICA: Cartago: "i den taette Urskov ved Turrialva," May, *Oersted 10706* (holotype: C, photos: F! US!).

*Odontonema amicorum* V. M. Baum, Brittonia 34: 425. 1982.—TYPE: BELIZE. Toledo: Temash River, 100 ft, 3 May 1935, *Schipp 1353* (holotype: K!; isotypes: A! CAS! F! G, MICH! NY).

Shrub to 3 m tall, young stems subquadrate to quadrate-sulcate, pubescent with flexuose to retrorse to retrorsely or antrorsely appressed (often crinkled or kinky) eglandular trichomes 0.2–1 mm long, trichomes usually ± concentrated in 2 lines. Leaves subsessile to petiolate, petioles to 16 mm long, blades ovate to elliptic to obovate-elliptic, (47–) 155–315 mm long, (16–) 60–117 mm wide, 1.9–4.8 times longer than wide, acuminate to falcate at apex, abruptly acute to attenuate at base, surfaces pubescent with cauline-type trichomes (often concentrated along major veins) or glabrate. Inflorescence of loose, terminal, pedunculate, unbranched dichasiate racemes to 600 mm long, 8–15 mm in diameter near midpoint of fertile portion, rachis pubescent with cauline-type trichomes usually in 2 or more lines; dichasia mostly whorled at nodes, 1–3- or more-flowered, sessile. Bracts lanceolate to lance-subulate, those near middle of inflorescence 2.5–5.5 mm long, 1–1.5 mm wide, abaxial surface pubescent with cauline-type trichomes or glabrate. Bracteoles and secondary bracteoles lance-subulate, 1.5–3.5 mm long, 0.5–0.6 mm wide, abaxial surface pubescent with cauline-type trichomes or glabrate. Flowers pedicellate, pedicels 2–6 mm long, pubescent like rachis. Calyx 2–3.5 mm long, tube 0.5–1 mm long, lobes subulate, 1.5–3 mm long, 0.6–1 mm wide, abaxially pubescent like bracts. Corolla red, 24–33 mm long, externally glabrous (although margins of lobes ciliolate), tube 20–27 mm long, expanded distally into a distinct throat, 9–13 mm long, 3.2–6 mm in diameter (measured flat) near midpoint, upper lip 4–8 mm long, lobes rounded, 2–6 mm long, 1.5–3.8 mm wide, lower lip 4–8 mm long, lobes elliptic to subcircular, 4–7 mm long, 2.5–4.5 mm wide. Thrum stamens 12–15 mm

long, pin stamens 6.5–8 mm long, thecae 2–2.8 mm long; pollen 3-colporate; staminodes 1–4 mm long. Thrum style 10–16 mm long, pin style 22–26 mm long, the style usually proximally pubescent with eglandular trichomes; stigma bilobed, lobes equal, 0.2–0.4 mm long. Capsule 17–23 mm long, glabrous, stipe 7–11 mm long, head 10–13 mm long. Seeds subcircular to subelliptic to broadly obovate in outline, 4–5 mm long, 2.5–3.5 mm wide, surface bumpy to tuberculate. Chromosome number: $n = 21$, Daniel et al. 1990.

Phenology. Flowering: January–July; fruiting: March–July.

Distribution. Mexico (Chiapas, Quintana Roo, Tabasco; Fig. 5), Belize, Guatemala, El Salvador, Honduras, Nicaragua, Costa Rica, Panama; in lowland rain forests, lower montane rain forests, and cloud forests; 30–1650 m.

I have adopted the epithet traditionally used for this species, that published by Bertoloni based on a Guatemalan collection. Nees (1847) and Baum (1982a) used this epithet despite not having seen the holotype at BOLO. Although I have not seen the holotype either, the microfiche image of it reveals a plant of *Odontonema* apparently compatible with my concept of the species. It has sessile dichasia and a corolla with a conspicuously ampliate throat. It is not possible to discern from the microfiche whether the dichasia are whorled. Baum (1982a) and Durkee (1986) used the spelling "tubiforme" (tube-shaped) for the epithet of this species; it is clear from Bertoloni's protologue that he intentionally used the spelling "tubaeforme" (trumpet-shaped).

*Odontonema pantasmense* was included in the synonymy of this species by Baum (1982a). It is difficult to establish from the photo of the type whether it indeed belongs here. In the photo, the dichasia appear to be sessile. Also, the type locality indicates this species; *O. tubaeforme* is only species reported from Nicaragua.

*Odontonema flagellum* was also included in the synonymy of this species by Baum (1982a) and Durkee (1986). From a photo of the type, it is clear that the corolla with a distinct throat and a large, bilabiate limb is very much like that of *O. tubaeforme*; the dichasia appear to be sessile and some are whorled. Also, *O. tubaeforme* is the only species of the genus known from Costa Rica, and other collections of it are known from the vicinity of Turrialba.

*Odontonema amicorum* is included in the synonymy of this species for the first time. Baum (1982a) indicated that *O. amicorum* differed from other species in the *O. callistachyum* complex by its oblong leaf blades and compact, spikelike raceme. The shape of the leaf blades varies from ovate-elliptic to elliptic on specimens of the type and in Baum's (1982a) illustration. Likewise, similar inflorescences are encountered throughout the *O. callistachyum* complex. The type, and only known collection, of *O. amicorum* was purported to have been a vine. There is no evidence of vinelike habit (i.e., twining or bending of stems or specialized structures for climbing) on the type collection. The whorled, sessile dichasia with pedicellate flowers, the red corollas with a throat 12 mm long, and the bifarious pubescence of the rachis with trichomes 0.2–0.4 mm long are all character states that allow placement of this species in *O. tubaeforme*. A vinelike habit sometimes is noted also (erroneously?) among Mexican collections of *O. tubaeforme* (e.g., *Cowan et al. 2853*).

I have not seen the type of *Thyrsacanthus longifolius*, but Baum (1982a) did and included the name as a synonym of this species. Oersted's description in the protologue is not very diagnostic, but the type locality (in the vicinity of Nicaragua near Tortuga) would indicate this species as well.

*Eranthemum coccineum* was included in the synonymy of *O. cuspidatum* by Baum (1982a). Both the figure and the description in the protologue pertain to *O.*

*tubaeforme* as delimited here. For example, both reveal inflorescences with sessile (possibly ternate) dichasia and corollas with long, wide throats.

Baum (1982a) included specimens from Jalisco, Michoacán, Puebla, and Oaxaca within her concept of *O. tubaeforme*. The specimen she cited from Jalisco (i.e., *Dieterle 3990*) is *O. callistachyum*; the specimen she cited from Oaxaca (i.e., *Mexia 9150*) is *O. cuspidatum*; the specimen she cited from Michoacán (i.e., *Langlassé 974*) is *O. cuspidatum* (as correctly annotated by her at F); and the specimen she cited from Puebla (i.e., *Seler & Seler 3770*) is *O. callistachyum* (as correctly annotated by her at NY).

A specimen from the Pacific coast of Chiapas (Acacoyagua, 15 Jan 1948, *Matuda 17433*, F) with "mars orange" corollas was annotated by Baum as *O. tubaeforme*. In its opposite, sessile to subsessile dichasia and glabrous rachis it more closely resembles *O. glaberrimum*. It differs from the latter species, however, and resembles the former by its bifarious cauline pubescence with retrorse trichomes to 1 mm long, elongate inflorescence, and tuberculate seeds. Neither species is known from the vicinity of this collection, and *Matuda 17433* is not included in either species at this time.

While Mexican specimens of *O. tubaeforme* are generally uniform and readily recognized using the key to species above, the species as it occurs in Central America becomes somewhat more variable. The rachis pubescence varies from nearly absent to somewhat more like that of *O. cuspidatum*. The sessile, mostly whorled dichasia and red corollas still distinguish the species there, however.

Additional Specimens Examined. **Mexico.** Chiapas: Palenque, *Armour 243* (F, US); Mpio. Las Margaritas, near San Quintín along Río Jataté, *Breedlove 9121* (DS, US); Mpio. Palenque, 6–12 km S of Palenque on rd to Ocosingo, *Breedlove 24210* (DS, DUKE, MEXU), *34955* (DS, MEXU); Mpio. Ocosingo, ruins of Yaxchilán on banks of Río Usumacinta, *Breedlove 33909* (DS, MEXU); Mpio. Palenque, near Cascada Mizola, 25 km S of Palenque on rd to Ocosingo, *Breedlove & Almeda 57340* (CAS); Mpio. Ocosingo, 70 km SW of Palenque on rd to Ocosingo along the Jol Uk'um, *Breedlove & Keller 49520* (CAS); Mpio. Las Margaritas, confluence of Río Ixcán with Río Lacantum (Río Jataté) on Guatemala border, *Breedlove & McClintock 34236* (DS, MEXU); 8 km O de Palenque, cerca de la Cascada Matiepa, *Cabrera & de Cabrera 3942* (CAS); 9 km S de Palenque, sobre la carretera Palenque–Ocosingo, *Cabrera & de Cabrera 8164* (CAS); los alrededores de las ruinas de Palenque, *Cabrera et al. 2663* (BM, MEXU); Ocozocoautla, between El Refugio and Rancho Aguajito, *Carlson 2104* (F, MICH); between Palenque and Ocosingo, 19.2 mi N of Río Tulija and 27.8 mi N of turn to Agua Azul, *Daniel & Bartholomew 4991* (CAS, K, MEXU, MICH, US); Mpio. Palenque, Zona Arqueológica de Palenque, *Fernández N. 1033b* (MEXU), *Ventura A. 19988* (MEXU); Palenque ruins, *Hoover 137* (MEXU, US); Mpio. Ocosingo, 8 km S de Benemérito de las Américas, camino a Flor de Cacao, en Zona Marqués de Comillas, *Martínez S. 11645* (CAS, F); Mpio. Ocosingo, 8 km S de Benemérito de las Américas, camino a Flor de Cacao, *Martínez S. 11735* (MEXU); Mpio. Ocosingo, 15 km NW de Boca Lacantum camino a Palenque, *Martínez S. 11903* (MEXU); Mpio. Ocosingo, Ojo de Agua de San Javier, 24 km NW de Crucero Corozal, *Martínez S. 15773* (MEXU); Mpio. Ocosingo, 2 km N de Tanhi Perla camino a Monte Líbano Ocosingo, *Martínez S. 17634* (CAS); between Ocosingo and Palenque, *Mayo & Madison 365* (K); ca. 5 mi from Palenque toward Ocosingo, *McDade 205* (DUKE); ruinas de Palenque, *Seler & Seler 5468* (CAS); ruins, 5 km SW of Palenque, *Sutherland s.n.* (CAS); 7 km S de Palenque, camino a Ocosingo, *Téllez V. et al. 5799* (MEXU); Palenque Archeological Site, 3 mi S of Palenque, *Thorne & Lathrop 40564* (DS); Pichucalco, half way between Chiapa de Corzo, *Walker & Walker W660207* (CAS).—Quintana Roo: 25 km N de La Unión en camino a Agua Blanca, *Téllez & E. Cabrera 2449* (MEXU).—Tabasco: Mpio. Tacotalpa, Cerro del Madrigal, 7 km de la Est. Tacotalpa hacia Tapijulapa, *Cowan et al. 2853* (CAS, MEXU); Mpio. Tenosique, 3.5 km arriba de la ruta Tenosique–Emiliano Zapata en el camino que va a la torre de televisión, cerca al puentes Boca del Cerro, *Cowan & Curiel 4683* (CAS); Boca Cerro, Tenosique, *Matuda 3566* (MICH); Hwy 186, 2.2 mi W of Tabasco–Chiapas border, ca. 33 mi E of Macuspana, *Reznicek et al. M175* (MICH); Mpio. Teapa, Grutas del Coconá, *Ventura A. 20161* (CAS); Mpio. Macuspana, Agua Blanca, *Ventura A. 20945* (CAS).

### Excluded Names

*Justicia corymbulosa* Bertol., Novi Comment. Acad. Sci. Inst. Bononiensis 4: 404. 1840.—Type: Guatemala. Escuintla: Escuintla, 1836, *Velázquez s.n.* (holotype: BOLO, microfiche!).—Gibson (1974) included this name in the synonymy of *O. callistachyum* based solely on the description in the protologue. Several characteristics of the plant noted in Bertoloni's description (e.g., calyx 4-lobed, and entire plant glabrous) are at significant variance with *O. callistachyum*. Baum (1982a) did not include this name. The microfiche of the holotype at BOLO reveals a specimen of *Odontonema* with conspicuously pedunculate dichasia, a feature more suggestive of *O. cuspidatum* than *O. callistachyum*. Although *O. cuspidatum* is not known from wild populations in Guatemala, it is widely cultivated in tropical America. Until the holotype can be fully studied, I exclude this name from the synonymy of *O. callistachyum*.

*Odontonema foliaceo-bracteatum* (Oerst.) Kuntze, Revis. gen pl. 2: 494. 1891. *Thyrsacanthus foliaceo-bracteatus* Oerst., Vidensk. Meddel. Dansk Naturhist. Foren. Kjøbenhavn 1854: 446. 1855. *Buceragenia foliaceo-bracteata* (Oerst.) V. M. Baum, Brittonia 34: 433. 1982.—Type: Mexico. Veracruz: Mirador, Oct 1841, *Liebmann 10707* (holotype: C!).—In the protologue Oersted expressed some uncertainty about the generic position of this species. The type shows flowers in axillary clusters, and Wasshausen annotated the specimen as *Buceragenia ruellioides* Leonard. Baum (1982a) transferred the species to *Buceragenia*. As *Buceragenia* would appear to represent species of *Pseuderanthemum* with cleistogamous flowers, the ultimate disposition of this species must await further studies.

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# EUPHORBIACEARUM SERTUM NOVO-GALICIANARUM REVISARUM

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This contribution should be regarded as complementary to a previously published paper dealing with new and otherwise interesting members of the Euphorbiaceae, of the genera *Chamaesyce* and *Euphorbia* (McVaugh 1993). As in that paper, data on some individual species are presented below essentially in the form of treatments for the *Flora Novo-Galiciana*, with concentration on the same area. A map of Nueva Galicia, and an index to localities, may be found in *Flora Novo-Galiciana*, volume 17, pp. 436–453. 1992, or in the same work, volume 13, pp. 450–467. 1993. In the following pages the citations of specimens include mention of the herbaria in which the individual specimens have been seen; these herbaria have been indicated by the appropriate acronyms, as listed in *Index Herbariorum*, edition 8 (New York 1990). For the privilege of loans of types and other critical material I am indebted to many herbaria, and especially to the curators and staffs at BH, C, CAS, CHAPA, DAV, F, G, GH, IBUG, IEB, K, MEXU, MICH, MO, P, POM, TEX, UC, US, WIS, and ZEA.

## ACALYPHA

**Acalypha delgadoana** McVaugh, sp. nov., frutex monoicus ramosus, ramulis rufis puberulis lenticellatis; folia sparsim setulosa vel hispidula, petiolis quam laminis multo brevioribus, laminis lanceolatis (2.5–) 4–10 cm longis, (0.8–) 1.5–2 (–3) cm latis, 3–4-plo longioribus quam latioribus; spicae ♀ terminales solitariae, 3–6 cm longae tenues, bracteis 25–40 inter se distantibus, unifloris, hispidulis, vix minuteve glandulosis, 6–7-dentatis, maturitate plerumque explanatis, ca 2.5–3 mm latis, 2 (–3) mm longis, dentibus triangularibus vel deltoideis, subaequalibus vel dente centrali prolongato; spicae ♂ axillares, filiformes subsessiles ca 3.5 cm longae; styli 2.5–3.7 mm longi, multifidae; capsula 3-lobata hispida ca 3 mm lata, conspicue verrucosa; semina ca 1.6 mm longa.

Hillsides in pine-oak forest, known only from foothills of the Pacific slope in western Jalisco, ca 500–750 m, flowering and fruiting in July.

Jal., Mpio. Cabo Corrientes, ca 20 km S of Puerto Vallarta and 20 km from El Tuito (*A. Delgado S. 357*, MICH, the holotype, MEXU, isotype; *Delgado 355, (*CHAPA, MEXU, MICH); km 4.5, road toward the mines of Zimapán [from the road-jct. N of El Tuito] (*Pérez de la Rosa & Puga 1571*, IBUG).

Shrub, reported as 70–90 cm high, branched above, the woody branches up to at least 5 mm in diameter, fluted in drying, with reddish brown bark and large lenticels; branchlets finely puberulent, usually with some curved coarser hairs as well; leaf-blades setulose adaxially, the hairs up to more than 1 mm long, thickened at base and sometimes with a basal ring of thick-walled cells; abaxial surface

hispidulous, mostly on the veins; stipules conspicuous but falling before the leaves mature, narrowly triangular or triangular-subulate, scarious, reddish, 2–3 mm long, 0.5–0.7 (–1) mm wide at base; petioles stout, 10–17 (–30) mm long, much shorter than the blades; blades lanceolate, (2.5–) 4–10 cm long, (0.8–) 1.5–2 (–3) cm wide, 3–4 times as long as wide, long-acuminate and sometimes falcate at apex (seldom merely acute), shallowly cordate or emarginate at the rounded base, pinnately veined but the lateral veins steeply ascending; margins shallowly crenate-serrate with (20–) ca 30 teeth on each edge; abaxial leaf surfaces green (as in the type), or dark red; ♂ spikes [one seen, past flower] axillary, filiform, interrupted, ca 3.5 cm long, nearly sessile, the flowers and floral bracts hispidulous; ♀ spikes clearly terminal, 3–6 cm long (on peduncles 3–12 mm long), 3–4 mm in diameter, flexuous, the 25–40 bracts loosely scattered along the axis, often (1–) 3–5 mm apart; ♀ bracts 1-flowered, hispidulous, 1–1.5 mm long in flower, ca 6–7-toothed; fruiting bracts usually explanate, ca 2.5–3 mm wide, the teeth triangular-deltoid, acute, sometimes sparingly and finely stipitate-glandular on the margins, more or less equal and ca 1 mm high and the bract 2 mm long, or the central tooth prolonged, up to 2 mm long and 1 mm wide at base and the bract then ca 3 mm long; styles red, 2.5–3.7 mm long, multifid half their length or more; ♀ sepals persistent, membranous, sometimes reddish, triangular-ovate, ca 0.7–0.8 mm long, 0.3–0.4 mm wide at base; capsule deeply 3-lobed, hispid, ca 2 mm high and 3 mm wide, covered on the distal half by narrow fleshy erect spinelike processes up to ca 0.4 mm long; columella persistent, stout, oblong, ca 1–1.3 mm long, 0.5 mm thick, acutely 3-angled, 3-pronged at apex; seeds elliptic-ovoid, acute, gray-brown, 1.6 mm long, 1.2 mm wide, smooth, cellular-reticulate, with a fleshy oblique crest.

This species is like *Acalypha cincta* and *A. schiedeana* in its shrubby habit, its terminal, elongate and usually solitary ♀ spikes, and ♀ bracts with relatively few teeth. It is, however, as far as I can determine, unique in having the combination of very narrow leaves, sparse and mostly eglandular pubescence, and very slender ♀ spikes with short bracts exposing the capsules. The capsules in *A. cincta* normally surpass and conceal the bracts, as they do infrequently in *A. schiedeana*, but both these species are amply distinct from *A. delgadoana* in other ways, as indicated below. All the following are characterized by having long terminal ♀ spikes on stems or branches usually solitary, unaccompanied by subordinate lateral (axillary) ♀ spikes; teeth of the ♀ bracts, if more than about 10 in number, setose but not glandular-ciliate (rare exceptions in *A. schiedeana*, with rigid acicular-subulate stipules often 6–10 mm long).

1. Leaf-blades lanceolate, (2.5–) 4–10 cm long, (0.8–) 1.5–2 (–3) cm wide, 3–4 times as long as wide, thinly setulose or hispidulous; ♀ bracts in fruit 2–3 mm long, the 6–7 teeth finely and sparingly stipitate-glandular on the margins. *A. delgadoana.*

1. Leaf-blades ovate or broadly ovate, commonly 3–5 cm wide or wider, and rarely more than 2–2.5 times as long as wide; ♀ bracts various.
   2. ♀ bracts 2-flowered, 10–15 (–17)-toothed, setose (not glandular); young herbage and stems densely and stiffly whitish pilose. *A. mollis.*
   2. ♀ bracts 1-flowered, (5–) 7–9-toothed, stipitate-glandular or essentially glabrous.
      3. Stipules acicular-subulate with rigid tips, (2.5–) 6–10 mm long; leaf-blades light green, membranous, strigose when young but mostly nearly glabrous at maturity, the lamina when dry copiously papillose; ♀ spikes up to 10 mm thick, the bracts in fruit 4–5 mm long, in ours 7 (–11)-toothed, sparingly stipitate-glandular on the margins or seldom on the outer surface as well. *A. schiedeana.*
      3. Stipules nearly linear, ribbon-like, membranous, up to 8–10 mm long and 0. 8–1 mm wide at base; blades green (often drying a bronzy green), with narrow paler green margins, the abaxial surface sometimes dark red except the green margin; blades densely

pubescent and often much whitened when young, in age sometimes glabrescent, the lamina usually not noticeably papillose; ♀ spikes up to ca 6 mm thick in fruit, the bracts 2–2.5 mm long (surpassed and hidden by the capsules), (5–) 7–9-toothed, glabrous or strigose, not glandular. *A. cincta.*

**Acalypha gigantesca** McVaugh, sp. nov., frutex subglaber, ramis glabris; petioli adaxiale pilis brevibus curvatis instructi; foliorum laminae ovatae, caudato-acuminatae, usque ad 7 cm longae, in superficiebus ambabus pilis sparsis subrigidis 0.5–1 mm longis instructae, et basi in venarum axillis pilorum longiorum caespite denso ornatae; spicae ♂ non visae; spicae ♀ terminales solitariae, bracteis subfoliaceis 1–2-floris (flore unico evolventi), glabris eglandulosisque, 10–14-dentatis, apertis 8–10 mm latis, 4.5–6 mm longis (–10 mm, dente centrali 2–2.5 mm ultra ceteris prolongato includenti); styli ca 5–6 mm longi, ramosi; ovarium glabrum; capsula tota glabra, laevis.

Known only from a single poor specimen, *A. Flores M. & Patricia Ramos G. 2901*, MICH, the holotype, collected in Jalisco, Mpio. La Huerta, Puente de Arroyo seco, ca 5 km W of Ej. Miguel Hidalgo, in tropical subdeciduous forest, with immature fruit 15 Aug 1991, 40 m elevation.

Shrub 1 m tall; branches glabrous, the leaves glabrous except for scattered stiff hairs 0.5–1 mm long on both surfaces (especially on younger leaves), a conspicuous abaxial tuft of longer hairs at the base of the blade, similar but smaller tufts in the axils of the foliar veins, and an adaxial line of stiffish curved hairs on the petiole; stipules subulate, deciduous, up to 3 mm long; petioles (probably not of full-sized leaves) 1.5–2 cm long; blades (probably not as large as ordinary cauline leaves) ovate, up to 7 cm long and 3 cm wide, caudate-acuminate, auriculate-emarginate at the rounded base; margins shallowly serrate with 15–18 teeth on each edge; blades palmately 7–9-veined at base, the veins pale abaxially and prominently convex; ♂ spikes and flowers unknown; ♀ spikes terminal, green with a reddish tinge, 2–2.5 cm long, more than 1 cm wide when pressed; ♀ bracts 1–2-flowered (1 flower developing), subfoliaceous, glabrous, not glandular, reniform (when opened), then 8–10 mm wide, serrate with 10–14 teeth, the body of the bract 4.5–6 mm long with central tooth prolonged 2–2.5 mm beyond this, falcate-acuminate, the lateral teeth sharp, antrorsely curved, ca 0.5 mm high; ♀ sepals triangular-acuminate, sharp-pointed, 0.7 mm long; ovary and capsule glabrous; styles ca 5–6 mm long, with slender distal branches; capsule smooth, 3-lobed, oblate, ca 3 mm in diameter (probably slightly immature), ca 2.5 mm high; seeds not seen.

In the context of the *Flora Novo-Galiciana* this is an extraordinary species. Our other species of the genus *Acalypha* are almost never glabrous to the extent described above, a smooth and glabrous ovary is rare in *Acalypha*, the prolonged central tooth of the ♀ bracts is unusually prominent, and the large tuft of hairs at the base of the leaf-blade is a very unusual feature. In the following key it is contrasted with similar-seeming shrubby species.

1. All spikes axillary, the branches indeterminate in growth.
   2. Plants eglandular or nearly so (glands, if present, sessile and inconspicuous among the hairs); ♀ bracts eglandular; seeds 1.1–1.3 mm long; veins of the abaxial leaf-surface sparingly beset with stiffish antrorsely curled or straight hairs, the surface itself eglandular. *A. vagans.*
   2. Plants more or less beset with gland-tipped hairs; ♀ bracts with marginal glands on the teeth and often on the abaxial surface; veins of the abaxial leaf-surface copiously fringed with soft straight hairs standing more or less at 90° from the vein, the surface itself bearing very short-stalked dark glands.

3. Seeds 1.7–2 mm long; habitat mostly 2000 m or higher; larger leaf-blades 7–13 cm long, commonly with 30–35 (–45) teeth on each edge; covering of gland-tipped hairs usually extensive, the whole plant often resinous. *A. langiana* var. *vigens*.
3. Seeds 1–1.3 mm long; species mostly of lowlands, up to ca 1500 m; larger leaf-blades 4–7(–?10) cm long, commonly with 20–25 ( 30) teeth on each edge; covering of gland-tipped hairs conspicuous and resinous, or often fine, pale or whitish, evident mostly on the ♀ bracts. *A. langiana* var. *langiana*.

1. Terminal spike present, ♀ (sometimes with a few ♂ flowers or a sterile seta at the tip), usually much larger than the ♀ spikes (if any) in the upper axils; branchlets glabrous; ♀ bracts glabrous, eglandular, up to ca 7 mm long with 10–14 teeth, including a prolonged central tooth 1–2 mm long; ovary and capsule smooth, glabrous; leaf blades ovate, thinly strigose adaxially and with a large tuft of pale hairs (mostly abaxial) at the base and smaller tufts in the larger vein-axils, otherwise glabrous. *A. gigantesca*.

**Acalypha lagopus** McVaugh, sp. nov., annua, bractearum ♀ dentibus maioribus 5–6, basibus deltoideis, apicibus setosis filiformibus vel subulatis 2–3 mm longis longe setosis instructis; spicae ♂ ut videtur terminales, 5–20 mm longae, pedunculis ca aequilongis suffultae; spicae ♀ axillares et ut videtur terminales, compactae, ellipsoidales vel suborbiculares, 10–28 mm longae, 8–15 mm diametro; styli indivisi; foliorum laminae ovatae vel suborbiculares, plerumque obtusae, 1–2 (–4) cm longae.

Areas of old lava flows, with *Cordia*, *Amphipterygium, Apoplanesia*, weedy in fields and on roadsides, along irrigation ditches, 300–400 m, flowering and fruiting Aug–Sep as far as known.

S and w Michoacán in the basins of the Río Tepalcatepec and Río Balsas, reaching our area near Apatzingán ("4 mi" NW of Apatzingán, *McVaugh 17917*, MICH, the holotype; 11–13 km WSW of Apatzingán, road to Dos Aguas and Aguililla (*Dieterle 4261*, MICH; Mpio. Parácuaro ["Antúñez"], *C. Rodríguez & Quezada 1360*, CHAPA), and also known from Mpio. San Lucas ["Distr. Huetamo"], Santa Cruz (*Hinton 6434*, K).

Annual or of indefinite duration from a stout upright taproot, as far as known with short central stem up to 6–8 (–?10) high, and longer prostrate decumbent basal branches; leaves usually opposite at the two lowest nodes, these separated by an internode 4–11 mm long, the branches from these nodes horizontally spreading, up to ca 20 cm long, with long (4–6 cm) proximal internodes and ascending tips; herbage puberulent with short curved hairs, the ♀ peduncles also hispid with stiff erect hairs up to 2 mm long, the leaf-blades mostly glabrous, ciliate-margined and with a few stiff superficial hairs; stipules triangular-subulate, caducous, strigose, less than 1 mm long; petioles filiform, 6–15 (–30) mm long; blades 0.9–2 (–4) cm long, (0.4–) 0.8–1.8 (–3) cm wide, ovate (often very nearly perfectly egg-shaped), or the lower ones suborbicular, obtuse at apex or seldom subacute, rounded at base; margins shallowly and often obscurely serrate (except in the basal third) with ca 8–15 teeth on each edge; leaves and inflorescences tending to be concentrated at the approximate distal node(s) of a branch, there often with 4–5 leaves subtending 1–3 axillary (or terminal) ♀ spikes and a single (?axillary) ♂ spike; small axillary spikes, both ♀ and ♂, occur occasionally at lower nodes, at least the ♀ apparently infertile, 1-flowered on a capillary peduncle; distal ♂ spikes 0.5–2 cm long, 1.5–2 mm thick, on erect capillary peduncles about as long as the spikes; ♀ spikes very compact, multibracteate, ellipsoid to orbicular, 10–28 mm long, 8–15 mm thick, the spreading filiform setose tips of the bracts conspicuous; ♀ bracts membranous, 4.5–7 mm long, lobed about half their length or a little more, when flattened flabellate, 5–7 mm wide at the bases of the lobes; lobes 5–6 (sometimes

with 1 or 2 additional outer lobes ca 1 mm long), with deltoid base and green subulate or filiform tips 2–3 mm long, these densely setose with spreading hairs 1–2 mm long, the proximal portion of the bract more thinly setose, especially on the nerves; styles undivided, 5–6 mm long; capsule deeply 3-lobed, ca 2 mm wide, 1.5 mm high, hispidulous and distally with weak setae up to 1.3 mm long; seeds elliptic-ovoid, acute, ca 1.5 mm long, 1 mm thick, smooth, minutely cellular-reticulate, with an oblique fleshy crest.

Most of the large ♀ spikes at the tips of the branches are clearly axillary, at nodes less than 5 mm apart; the solitary ♂ spike associated with them always seems to be subtended by a leaf, but whether it is in fact always axillary, I cannot ascertain. Among the annual species of which the ♀ bracts have 3–5 (–7) teeth with prolonged filiform setose tips, this one seems most likely to be confused with *Acalypha alopecuroidea.* These may be contrasted about as follows:

1. ♂ spikes seemingly terminal, 5–20 mm long, on erect peduncles about the the same length; ♀ spikes clustered at 4–5 approximate distal nodes; styles entire as far as known; leaf-blades nearly egg-shaped or suborbicular, mostly obtuse at apex, ca 1–2 (–4) cm long; basin of Río Tepalcatepec, w Michoacán. *A. lagopus.*
1. ♂ spikes axillary, (1–) 3–10 mm long, on weakly spreading peduncles mostly 2–3 mm long, usually arising in the same axils with ♀ spikes; at least some ♀ spikes appearing terminal, but most of them axillary, on peduncles 4–6 (–8) mm long; styles (in ours) mostly entire, sometimes irregularly bifid distally; leaf-blades broadly ovate to ovate-cordate, acuminate, 2.5–7 cm long, (1.3–) 1.4–1.7 (–2) times as long as wide; widespread in Nueva Galicia. *A. alopecuroidea.*

**Acalypha langiana** Muell. Arg. Linnaea 34: 159. 1865; in DC. Prodr. 15, part 2: 811. 1866.

*Acalypha vagans* [var.] β *glandulosa* Muell. Arg. Linnaea 34: 161. 1865; in DC. Prodr. 15, part 2: 829. 1866. ?*Acalypha brachyclada* Muell. Arg. in DC. Prodr. 15, part 2: 862. 1866. *Acalypha palmeri* Pax & Hoffm. Pflanzenreich IV. 147. xvi [Heft 85]: 157. 1924.

Steep bluffs and rocky hillsides, *matorral subtropical*, pine-oak forest, tropical deciduous forest with *Brosimum*, *Lysiloma*, *Coccoloba*, *Hura*, thorn forest with *Haematoxylum*, sea-level to ca 1500 m in the Pacific lowlands and foothills, flowering Jun–Sep or almost throughout the year. Similar plants from higher elevations, up to ca 2350 m, are discussed below.

Son., Dgo., Nay., Jal., Col. (Manzanillo, *Palmer 941* in 1890, US!, isolectotype of *A. palmeri*; MICH negs. 1342!, 1343!), Mich., Gro. (Baqueta, *Langlassé 497*, syntype of *A. palmeri*), Oax. ["in valle Oaxacana prope Quilapa (*Liebm.* ! a cl. Lange commun. )," the type; G!, a young ♀ fragment, lectotype, here designated, *Liebmann 5749*, 4 sheets, C!, isolectotypes; "prope Guatulco in Mexico occidentali," *Liebmann* (*5782*), C!, lectotype here designated of *A. vagans* β *glandulosa*]. The type of *A. brachyclada* was cited as "In Peruvia aut in Mexico (hb. Pavon! nunc in hb. Boiss. )." The presumed holotype, at G! ex herb. Boiss. (a fragment in G-DC!), bears a ticket (?written by Pavón), "Croton glandulosum," with no indication of geographical origin. It is a flowering branch of a stipitate-glandular shrub, apparently with all spikes axillary, mostly ♂.

The specimens of *Liebmann 5749* at C bear ♀ spikes only, as indicated by the description in the protologue. Except that the spikes are younger, they are a good match for *Palmer 941* at US, the lectotype of *Acalypha palmeri*. The herbage is densely stipitate-glandular, the leaves are coarsely dentate, and many of the ♀ spikes end in a sterile seta. There is no indication that Mueller Argoviensis actually

saw any of the material at Copenhagen; none of the four sheets bears his characteristic annotation-label. Mueller did not state without qualification, as he often did, that he had seen the material "in hb. copenh." Of *A. langiana* he added "a cl. Lange inter messem Euphorbiacearum copiosam a cl. Liebm. lectam benevole communicata."

The material of A. *vagans* β *glandulosa* at C bears Mueller's annotation. It is a flowering specimen consisting of three branches. I cannot distinguish it from *Acalypha langiana*. Mueller included it in an informal grouping of species that he called *Acrogynae*, described as having "spicae foem. terminales saepeque et axillares," that is, with at least some ♀ spikes terminal. The specimens are so young that it is difficult to be sure, but it appears that all the spikes are axillary with the younger ones toward the tips. The only species in western Mexico with which it is likely to be confused is *A. subviscida*, and in that the terminal ♀ spikes are usually conspicuously terminal, and commonly develop at a very early stage of flowering, often ahead of the axillary spikes below them.

In the type-material of *Acalypha palmeri*, as in the majority of our specimens referred here to *A. langiana*, the terminal tooth of the ♀ bracts is notably prolonged, whereas *A. langiana* was originally described as having the terminal tooth "reliquis nec majore nec productiore." This particular variation does not appear to be taxonomically significant. Both in the lowland and highland representatives of *A. langiana*, bracts with and without a prolonged central tooth may be found on the same plant.

The species-complex that in Mexico includes *Acalypha langiana* and *A. umbrosa* Brandg., namely an assemblage of shrubby monoecious plants with all inflorescences axillary, and the herbage sparsely to densely vestite with gland-tipped resinous hairs, is in need of further study. The number of available collections is not large, and collectors need to make additional field-observations on variation in local populations. Specimens that have been called *A. langiana* vary from examples with few small pale glands and those nearly confined to the ♀ bracts, to resinous-glandular to such an extent that the herbage is covered and darkened by the glands. This dense covering of glands is particularly noticeable in highland populations (mostly 2000 m and above), but is not confined to them. In addition to the variation in glandularity, sexual expression varies from plant to plant in ways that I cannot explain. It may be that the glandularity is controlled largely by genetic factors, but at least in some instances the sexual expression, i.e., the relative numbers of ♂ and ♀ spikes produced, seems to be influenced by the environment. The most common situation seems to be that in which a majority of the plants at one locality produce mostly ♂ spikes, these very often bearing one or few ♀ and fertile bracts on the peduncle near base. In at least one instance, at a lowland locality near Colima, most plants were of this description (*McVaugh & Koelz 1086* in 1959; *McVaugh 15503* in 1957), but a single plant that had been severely clipped or browsed (*McVaugh 15512*) was producing new shoots bearing exclusively long multibracteate ♀ spikes.

In individual plants with numerous ♂ spikes, these seem to develop before the ♀ spikes in the upper axils. Some individuals with mature ♀ spikes in the upper axils, however, may bear at the same time undeveloped ♂ spikes elsewhere on the plant. In an isotype of *Acalypha palmeri* (*Palmer 941*, US), one branchlet bears ♀ spikes and another bears ♂ spikes with 1–2 ♀ flowers at base. The coordinating mechanism in this and some other groups of *Acalypha* deserves some study; it is possible that the same mechanisms have been involved in the

development of the dioecious habit and in the change from indefinite to definite growth-habit.

Similar states have been observed in the closely related and scarcely distinguishable montane plant of Nueva Galicia that in 1961 (Brittonia 13: 148, in key) I identified as *Acalypha umbrosa* Brandg. In general appearance and in many individual characters, this montane plant suggests a larger and more luxuriant version of the lowland *Acalypha langiana*, and I now believe it is best treated as a variety of that species. Study of the more ample material of *Acalypha umbrosa* now available shows that it is not identical with our montane plant, though surely closely related to it and to the lowland *A. langiana*. It is heavily glandular, resembling our montane plant in this respect, but the leaves in most specimens are shorter and more widely ovate, not conspicuously long-acuminate, with fewer and rounder marginal teeth, relatively longer petioles, and smaller ♀ bracts and seeds. It is evidently a somewhat modified insular taxon, but its position with respect to *A. langiana* remains to be clarified.

I have not been able to find any satisfactory way to separate the upland from the lowland populations of *A. langiana* except by seed-size, which seems consistently larger in the montane plants. In the latter, also, the glandular covering is usually darker and denser, more resinous; the leaves tend to be longer, relatively narrower and more narrowly acuminate, and with finer and more regular marginal teeth; the ♀ bracts at maximum size are longer and with more numerous teeth. All these characters except seed-size are somewhat subjective and inconsistent. The differences between the following two varieties are set forth in the key above, p. 176, under *Acalypha gigantesca*.

**Acalypha langiana** Muell. Arg., var. **langiana**. *Acalypha langiana* Muell. Arg., as to type.

**Acalypha langiana** Muell. Arg., var. **vigens** McVaugh, var. nov., monticola (regiones calidas non habitat), a var. *langiana* seminibus 1.7–2 mm (non 1–1.3 mm) longis, foliorum majorum laminibus multidentatis [dentibus utroque latere plerumque 30–35 (–45), vice 20–25 (–30)], differt.

Barrancas and steep slopes, in mixed montane forest with broad-leaved trees, or pine-fir forest with *Quercus*, *Styrax*, *Cornus disciflora*, *Meliosma*, *Ternstroemia*, *Symplocos*, *Tilia*, *Carpinus*, (1500–) 2000–2600 m, flowering and fruiting Aug–Apr.

Known from Jalisco only (northeastern slopes of Nevado de Colima, below Canoa de Leoncito (*McVaugh 13436*, sheet 2, the holotype, MICH). Not *Acalypha umbrosa* Brandg. Erythea 7: 7. 1899, which is known from B. C. Sur, and from the Revillagigedo Islands (Socorro I., *Anthony 375*, UC!, the holotype).

Jal., Mpio. San Sebastián (del Oeste), Hda. El Ototal (*Mexia 1682*); 15–30 km N of Mascota, road to San Sebastián (*Anderson & Anderson 5953*); Mpio. Talpa, km 12, *brecha* from Cuale to Talpa (*L. M. González 1104*, IBUG); n w slopes of Nevado de Colima, above Jazmín (*McVaugh 10030*); Sierra de Manantlán (many collectors: "15–20 mi" SE of Autlán, *Wilbur 1952*; steep ridge at 2160 m, road to El Guísar, *Breedlove 45728*, CAS; on the *bajada* S and W of the divide between Aserradero San Miguel Uno, and El Durazno, *McVaugh 13934*; 2–3.5 km NE of Las Joyas, *Judziewicz et al. 4913*, IBUG, WIS; on the ridge 7–8 km ESE of Las Joyas, 2400 m, *G. López & L. Guzmán 24*, ZEA); Mpio. Tecalitlán, Barranca La Resbalosa, ca 10 km SE of Llanitos, *brecha* to Plan de Lego (*Villa & Chávez 237*). (All specimens at MICH except as noted).

Slender arching shrub 1–2 m high, puberulent or hirsutulous with pale hairs, the hairs on mature branchlets often obscured by the numerous yellow or dark brown stout-stipitate glands, these especially abundant on the branchlets, inflorescence axes, petioles, and ♀ bracts, the leaf-blades sparingly or rather densely glandular, the whole plant fragrant, resinous; stipules flat, very early deciduous, narrowly triangular, 1.5–2.5 mm long, 0.7 mm wide at base; petioles 2–4 (–7) cm long, mostly less than half as long as the blades; blades ovate or long-ovate, the larger ones of the branches (below the narrower leaves of the upper nodes) 7–13 cm long, (2.5–) 3–6 cm wide, long-acuminate to caudate and commonly falcate at apex, 3-veined near base (with 1–3 pairs of smaller veins below this), rounded at base (often narrowed, then rounded and auriculate-emarginate), serrate nearly to the base, commonly with 30–35 (–45) teeth on each edge; spikes all axillary, those in the upper axils mostly ♂ with 1–2 ♀ flowers at base, or on some branches mostly or all ♀; spikes in the lower axils mostly ♂, up to 7 cm long, with one or few ♀ flowers at base; ♂ spike up to 7–10 cm long, 1.5–3 mm thick, pedunculate 1–2 cm; wholly ♀ spikes up to ca 5 cm long with up to 15 (–?20) flowering bracts; bracts 2-flowered, (3.5–) 4.5–7.5 (–13) mm long including the prolonged central tooth if any, and 9–12 mm wide, with (15–) 17–23 (–30) narrowly triangular acute teeth about twice as long as wide, 0.5–1.5 mm long (or a little more including the stout glands), the middle tooth sometimes up to 2–3 mm long, or scarcely longer than the others; outer surface of the ♀ bracts usually densely stipitate-glandular, the glands most abundant on the teeth, where in young bracts they may be as large as the teeth and confused with them; ♀ calyx-lobes ovate, acute, 1 mm long, glandular-dentate on the margins; styles 3.5–5 mm long, red, laciniate; capsule depressed, strongly 3-lobed, 3 mm wide, densely short-hispidulous and verrucose; seed ovoid, 1.7–2 mm long, nearly black, smooth minutely cellular-reticulate.

**Acalypha lovelandii** (McVaugh) McVaugh, comb. nov. *Acalypha subviscida* var. *lovelandii* McVaugh, Brittonia 13: 153. 1961.

Though this plant was first described as a variety of *Acalypha subviscida*, the resemblances in detail are not very close, except that in both the terminal spike is ♀, some of the upper axils support additional ♀ spikes, and the ♀ bracts are usually conspicuously stipitate-glandular. Specimens in which ♀ spikes have developed can usually be distinguished at a glance, because in *A. subviscida* they are loose and flexuous, with the bracts well separated on the axis, whereas in *A. lovelandii* they are compact, almost cylindrical, with the bracts crowded tightly except sometimes the lowest. Furthermore, in *A. subviscida* the lateral ♂ and ♀ spikes often develop from the same axils, and the axis of the ♂ spike often bears one or two ♀ bracts near its base, whereas in *A. lovelandii* the spikes of the two sexes are rigorously separated as far as I have observed, with the ♂ ones below the others on the axis, and never bearing a basal ♀ bract.

Humid ravines, ("barrancas, cañadas"), precipitous wooded slopes, pine-oak forest or humid montane forest with oaks and other deciduous trees, persisting in secondary vegetation, 1200–2100 (–3100) m, flowering and fruiting Jul–Dec.

?Nay., Jal., Mpio. Tamazula, above La Garita, highway from Colima to Jiquilpan (*McVaugh & Koelz 1343*, MICH!, the holotype; *McVaugh 18041*), Col., Mich., Gro., Mor.

Jal., Mpio. Tecalitlán, 3 km SE of San Isidro, *brecha* to Plan de Lego (*Villa & Chávez 285*, CHAPA, MICH); Mpio. Cd. Guzmán, ca 20 km above Fresnito,

*brecha* to Parque Nacional El Nevado (*Villa & Koch 245*, CHAPA, MICH); Col., s w foothills of the Nevado de Colima, "1–1.5 mi" above [S of] Hda. San Antonio, "ferny barrancas" (*McVaugh 16090*); Mpio. Comala, Rancho El Jabalí, hills above s side of Lago Calabozo (*Lott 2995*); Capilla la Hermita, ca 7 km W of Rancho El Jabalí, by the road from Hda. San Antonio to Comala (*Phillips 1033*); Mich., n w foothills of Cerro Tancítaro, 13–14 km S of Peribán de Ramos (*McVaugh 24839*). Probably the same species but the material imperfect, Jal., Mpio. Jocotepec, barranca de El Tezcalame, W of San Pedro Tesistán (*Machuca 6831*). Extralimital: Mich., Uruapan, ["northwest of town"] (*Pringle 10405*); Gro., Mpio. Chihihualco, Cruz de Ocote, ca 43 km [airline] W of Chilpancingo (*Rzedowski & McVaugh 287*). (All specimens at MICH except as noted).

The one known specimen from above 3000 m on the Nevado de Colima (*Villa & Koch 245)* is persistently and softly hairy, to a greater extent than any of the known specimens from lower elevations.

**Acalypha microphylla** Klotzsch in Seem. Bot. Voy. Herald 278. 1856. *Acalypha reptans* [var.] *α genuina, sensu* Muell. Arg. Linnaea 34: 48, as to name only. 1865. *Acalypha chamaedrifolia β genuina, sensu* Muell. Arg. in DC. Prodr. 15, part 2: 879. 1866, not *Croton chamaedrifolius* Lam., 1786.

This is apparently the oldest name for a species-complex that extends from Sinaloa to Central America, on the Pacific slope at elevations of less than 1500 m, and is most commonly found between sea-level and 1000 m. Both Mueller (1866) and Pax & Hoffmann (1924) relegated *Acalypha microphylla* to the synonymy of a not very similar West Indian species, *A. chamaedrifolia* (Lam. ) Muell. Arg., but in recent years much material from western Mexico has been treated as an inclusive A*calypha microphylla*. In Nueva Galicia there are in the complex at least three recognizable extremes, treated here as two species, one with two varieties, all having different habitat-preferences and more or less restricted ranges within the area. The complex includes one of the few taxa that seem perfectly at home on the ocean dunes. This prostrate plant of the seacoast, *A. microphylla* var. *microphylla,* is very different in appearance and in technical characters from erect weedy plants, treated here as *A. microphylla* var. *interior*, which are found farther inland, though often very near the coast. A second and seemingly more distinctive member of the complex is newly described below under the name of *Acalypha vallartae*. Except for the characters noted in the following key, all members of the complex are similar in many ways.

1. Plants prostrate on sea-beaches and dunes, with trailing branches up to ca 50–60 cm long; ♂ spikes dense, stout, as long (up to 1.5–2.5 times as long) as the peduncles, these (10–) 15–30 mm long. *A. microphylla* var. *microphylla.*

1. Plants erect or weakly so, in various habitats, sometimes near the ocean but not on the dunes; ♂ spikes more or less interrupted, slender to filiform, 3–6 (–12.5) times longer than the peduncles, these 5–15 mm long.
   2. ♀ peduncles 15–25 mm long (average ca 21 mm); ♀ bracts minutely hispidulous or strigulose, without conspicuous long stiff hairs; ♀ spikes linear, 3–4. 5 mm thick (average ca 4 mm); major leaf-blades 1.5–3.5 (–4.7) cm long, usually long-pointed, not abruptly acuminate; near the ocean, but above the coastal sands. *A. vallartae.*
   2. ♀ peduncles 2–12 (–20) mm long (average ca 8 mm); ♀ bracts more or less beset with stiff straight hairs; ♀ spikes oblong or ellipsoid, 4–7 (–10) mm thick (average ca 6 mm); major leaf-blades various in size, usually abruptly acuminate; habitat and range various. *A. microphylla* var. *interior.*

**Acalypha microphylla** var. **microphylla**. *Acalypha microphylla* Klotzsch, as to type. *Acalypha parvifolia* Muell. Arg. Linnaea 34: 161. 1865; in DC. Prodr. 15, part 2: 831. 1866. ?*Acalypha nicaraguensis* Pax & Hoffm. Pflanzenreich IV. 147. XVI [Heft 85]: 54. 1924, ex descr. and habitat.

Pacific coast, on and near the dunes and sea-beaches, sometimes with *Zizi-phus*, *Capparis*, and cacti, or *Prosopis*, *Coccoloba*, *Manihot*, *Hyperbaena*, 0–2 m, flowering Jul–Oct or throughout the year. Apparently the same variety found rarely farther inland, as in Mpio. La Huerta, between Nacastillo and Los Ranchitos, "postrado en lugar arenoso," 250 m (*A. Flores M. et al. 3083*, IBUG, WIS).

Sin. (Mazatlán, *Seemann 1521*, K! ex herb. Hook., the lectotype, *Seemann s.n.*, K! ex herb. Benth., presumed isolectotype), Jal., Col., Oax. ["prope S. Agustin ad mare pacificum (Liebm. ! in herb. Hafn. )" (*Liebmann 5760*), type of *A. parvifolia*, C!, det. Muell. Arg., lectotype here designated; G-DC!, a fragment, isolectotype; *Liebmann 5760* (8 sheets), C!, *Liebmann 5760*, US!, MICH negs. 1348!, 1349!, isolectotypes], Chis.; Centr. Amer. (Nicaragua, Corinto, *Brenning 175*, syntype of *A. nicaraguensis*, not seen).

The ample type-material at C of *Acalypha parvifolia* includes several specimens of the characteristic plant of coastal dunes, with thick woody root and trailing branches 30–40 cm long. The one specimen annotated by Mueller, like the fragment at G-DC, however, was an atypical plant, with upright much branched stems that appear somewhat woody at base, 15 cm high or less but with the basal parts wanting. This doubtless was the basis for Mueller's description of it as "Suffrutex circiter pedalis vel humilior."

Jal., Playa La Fortuna, on dunes, "6.7 mi" SW of the crossing of Río San Nicolás, "8.3 mi" NW of Chamela (*Keil & Luckow 15123*, CHAPA); Mpio. La Huerta, Salinas de Careyes, ca 7 km SE of the Estación de Biología Chamela (*Lott 2339, 2774*); on the beach at Barra de Navidad (*McVaugh 19737*); Col., Playa de Oro, W of Santiago, ca 25 km (airline) WNW of Manzanillo (*Stevens 1875*); w end of Bahía de Santiago, opposite Santiago (*McVaugh 15852*); opposite Manzanillo, w side of the bay (*Gregory & Eiten 328*); Mpio. Manzanillo, between El Ciruelo and Cuyutlán (*Gilly et al. 10*); dunes "1 mi" SE of Cuyutlán (*McVaugh 15598*). (All specimens at MICH except as noted).

Prostrate, many-stemmed from a deep-seated erect multicipital perennial taproot, forming circular mats up to 1 m or more across, sometimes flowering the first year and then appearing annual; herbage rather uniformly crisp-puberulent or short-pubescent with curved hairs, the leaf-blades nearly glabrous but usually bearing some short stiff appressed hairs, the ♀ bracts (especially on the lobes) usually subsetose, beset with stiff hairs up to 1.5 mm long; stipules linear-subulate, strigose, 1 mm long or less; petioles of major leaves 4–8 (–25) mm long; blades orbicular-ovate, palmately 3 (–5)-veined at base, the major ones 6–18 mm long and wide, firm in texture, acute to abruptly short-acuminate at apex, broadly rounded to cordate at base; margins dentate to acutely serrate (except at base) with 8–16 prominent teeth on each edge; ♂ inflorescences axillary, usually conspicuous, the spikes dense, dull red, (8–) 15–40 mm long, 1.5 (–2) mm thick, ca (0.5–) 1–1.5 (–2.5) times as long as the peduncles (10–) 15–30 mm long; ♀ spikes terminal (rarely androgynous, with a few ♂ flowers at tip), green, cylindrical, dense, when fully developed 10–25 mm long and 5–8 mm thick (not including the styles), erect, on peduncles 5–15 mm long; ♀ bracts 2.5–4.5 mm long, when unfolded flabelliform and 6–7 mm wide, with 7–9 triangular-acuminate teeth 1–2.5 mm long, up to 1.2–1.5 mm wide at base (the outer ones smaller), usually termi-

nating in a cusp 0.2–0.7 mm long; styles bright red, ca 5–6 mm long, divided two-thirds their length into slender branches; capsule oblate, ca 2.5 mm wide, distally verrucose and densely white-pubescent with partly stellate hairs; columella ca 1 mm long, prominently 3-angled; seed ellipsoid-ovoid, acute at apex, ca 1.3–1.5 mm long, 1–1.3 mm wide, dark reddish (almost black), smooth, finely cellular-reticulate, with a prominent white oblique apical/adaxial crest.

The type-fragment of *Acalypha parvifolia* at G-DC! and the type-material at C! are more nearly glabrous than most of our specimens, but two additional specimens from the Pacific beaches in Oaxaca, named by Mueller, are pubescent about as in ours. These are, "Chacalaca en la playa del Mar," SW by S from Cd. Oaxaca, Jul 1845 (*Jurgensen 115*, G!), and "Plage océan Pacifique," Sep (*Galeotti 344*, G!). Fragments similar to the last, at K! ex herb. Hook., and K! ex herb. Benth., represent *Galeotti 322*, from "Sand hills of the Pacific," Oax. I should refer all the above to *A. microphylla* var. *microphylla.*

Mature complete plants of this variety are unmistakable because of the prostrate habit, the many long branches arising from a multicipital crown, and the long-peduncled ♂ spikes. Short detached branches, often collected, are easily confused with examples of var. *interior*, especially if these are immature, or taken from malnourished plants, or deprived of some or most of the spikes of either sex. The lectotype of var. *microphylla*, *Seemann 1521*, consists of a detached leafy branch almost 60 cm long, with ovate obtusely pointed to acuminate leaf-blades 1–2.5 cm long, a few short ♀ spikes, and a few somewhat battered ♂ spikes 1–2 times as long as the filiform peduncles 10–15 mm long. The length of the type-branch, and the appearance of its base, suggest that it was originally a part of a large prostrate plant, and taken from a multicipital crown. All this in despite of the confusing description in the protologue of *A. microphylla*, where the plant is characterized as erect [!], "suffruticose," with leaves ovate to subrhombic, 4–6 inches [sic!] long and 3–4 lines wide, obtuse [!].

**Acalypha microphylla** var. **interior** McVaugh, var. nov., herba annua vel subperennis, plerumque erecta, copiose ramosa e radice tenui, caulibus usque ad 30–100 cm longis; raro valde hirsuta; folia parva vel mediocria, petiolis (7–) 25–60 mm longis, laminis majoribus 25–60 (–70) mm longis, latisque 17–35 mm; spicae ♂ filiformes, quam pedunculis brevibus multo longiores; spicae ♀ hispidulae, 8–16 (–23) mm longae, (3.5–) 5 (–7) mm latae, pedunculis 2–12 (–20) mm longis; bracteearum ♀ dentes cuspidati, cuspide 0.3–0.7 mm longa, dentibus majoribus 5–6 (–7), longitudine (0.6–) 1–2 mm. *Acalypha rhombifolia ?, sensu* Hook. & Arn. Bot. Beech. Voy. 310, name only. 1838. *Acalypha nicaraguensis* Pax & Hoffm. Pflanzenreich IV. 147. XVI [Heft 85]: 54. 1924, *quoad pl. Palmeri no. 935. Bernardia mazatlana* M. E. Jones, Extr. from Contr. West. Bot. 18: 49. 1933.

The specimen cited by name only, and with an indication of doubt, by Hooker & Arnott (Bot. Beech. Voy. 310. 1838) as *Acalypha rhombifolia* Schlecht., is at K!, marked "Mexico Beechey." It consists of branches of two (or perhaps three) small plants of *A. microphylla* var. *interior*, and two longer branches, perhaps from a single plant, of the hirsute variant of that variety.

Primarily a plant of moist shady forests and forest edges, hillsides and barrancas, in the Pacific lowlands often in palm [*Orbignya*] forest, or subdeciduous forest with *Orbignya*, *Brosimum*, *Psidium sartorianum*, spreading to roadsides and banana plantations, cultivated fields and orchards, sea-level to 700–800 m,

flowering Jul–Nov (–Mar); also apparently the same plant known from a few localities at higher elevations on the Pacific slope, in barrancas and stream valleys in areas of oak forest or humid montane forest supporting many epiphytes, 900–1450 m, flowering more or less throughout the year.

Fields, roadsides, forest edges, mostly in the Pacific lowlands, sea-level to 300 m, but apparently the same plant in disturbed places up to 1450 m, flowering Jul–Apr or throughout the year.

Sin. (Mazatlán, "on hillsides among rocks," *M. E. Jones 22626*, the cited type of *B. mazatlana*, POM!), Nay., Jal. (coastal highway 20 km SE of Tomatlán, 25 km NW of the bridge of Río San Nicolás, *McVaugh 25309*, MICH, the holotype), Col. (Manzanillo, *Palmer 935* in 1890, K!, syntype of *A. nicaraguensis*), Mich. Perhaps also near the coast southeastward to Oaxaca, and in Central America, but this not verified.

Nay., Mpio. San Blas, roadside through mangrove (*Norris & Taranto 13344*); San Blas, weed in town (*Clarke et al. 681231-18*); "2–9" mi W of Jalcocotán, road to Miramar (*McVaugh & Koelz 685*); Mpio. Pochotitlán, km 10–20 on road to Aguamilpa, disturbed deciduous forest (*Téllez 10834*); forested valley in oak zone, "9 mi" N of Compostela (*McVaugh 16448*; *McVaugh & Koelz 505*); sandbar in dry creek bed, 1 km N of El Cuatante, ca 40 km NNE of Puerto Vallarta, Jal. (*Feddema 2617*); Jal., Mpio. Cabo Corrientes, valley of Río Las Juntas, 10–13 km SE of El Tuito, weedy (*McVaugh 25356*); Mpio. Tomatlán, road to Llano Grande, 800 m (*Vázquez García 1122*, IBUG); Mpio. La Huerta (Hotel Careyes, a garden weed, *Lott 2843*; Estación de Biología Chamela, roadsides, *Lott 2315*); Mpio. Cihuatlán, ca "1 mi" NW of Melaque, road to Puerto Salud (*Webster & Breckon 16078*); coastal plain and stream-valley N of Barra de Navidad, road to Autlán (*McVaugh 20834*; *McVaugh & Koelz 1736*); Rancho El Alcíhuatl, 36 km W of V. Purificación, 400 m (*Ornelas U. & Luquín 1302*, IBUG); 500 m S of Tala, 1200 m, ruderal (*Montes Rodríguez 6*, IBUG); Col., littoral thickets near El Tesoro Beach on Manzanillo bay (*Webster & Breckon 16089*); cliffs W of Cuyutlán lagoon, near Manzanillo (*Ferris 6181*, MEXU); Mpio. Comala, Rancho Jabalí, road to Comala, ca 5 km SE of Hda. San Antonio, disturbed soil in road (*Sanders 10267*); Colima (*Palmer 1251* in 1891, K!). (All specimens at MICH except as noted).

The following description applies especially to the variety *interior*, but in general to all members of the complex, including *A. vallartae:*

Annual or of indefinite duration, from an erect annual or perennial taproot, sprawling or often erect and up to 50–100 cm high, or sometimes trailing and rooting along the stems; plants varying from nearly glabrous or puberulent to pubescent (see below for a variant densely hirsute with numerous fine straight hairs up to 6 mm long), the herbage usually pubescent with curved antrorse tapering colorless hairs, the abaxial leaf-surface and the ♀ bracts often with some stouter setae up to 1.2 mm long; stipules triangular-subulate, up to ca 2 mm long, early caducous; petioles 2–3 (–6) cm long, often as long as the blades or up to more than half as long; blades often as wide as long, (0.6–) 2.5–4 (–7) cm long, 2–2.8 (–5.3) cm wide, usually abruptly acuminate at apex, cordate to truncate or rounded at base, bluntly serrate except on the margins near base, with (8–) 11–18 (–21) teeth on each side; ♂ spikes axillary, often reddish, 1–4 (–7) cm long, 1–1.5 mm thick, often much longer than [up to 3–6 (–12.5) times as long as] the peduncles (these 5–15 mm long), often interrupted and the flowers in small well-separated clusters along the filiform axis, the sepals acute, often with projecting glands on the midrib near the tip; ♀ spikes terminal, often tipped with a sterile seta 5–6 mm long, stiff and densely bracteate, 1–3 (–4.5) cm long, 4–7 (–10) mm thick (ave. ca 6

mm), pedunculate, the peduncles 2–12 (–20) mm long (ave. ca 8 mm); ♀ bracts green or often reddish, (1.5–) 3–4 mm long, mostly 5–7-toothed (a few with 9–10 teeth, but some of these usually formed by division of the principal teeth), the teeth 1–1.2 mm long, deltoid-acuminate, or narrowly triangular and up to 2.2 mm long, all more or less (usually densely) pubescent and often with some setae, often with a very few stalked glands; styles red, (4.5–) 6–8 (–11) mm long, about 5-laciniate more than half their length; capsule densely white-setose or nearly glabrous, tuberculate, the hairs clustered at the tubercles and appearing stellate or dendritic; seeds plump, ovoid, 0.8–1.4 mm long, dark purplish red (almost black), smooth but minutely areolate in longitudinal rows.

Throughout the range of the above there is a superficially striking variant, indistinguishable except that some or all plants in a local population may be coarsely and often densely hirsute with stiff spreading pale yellowish 1-celled hairs up to 5–6 mm long (in some roadside populations, e.g. Nay., W of Jalcocotán, *McVaugh & Koelz 685*, cited above, strongly hispid plants are almost as abundant as those having appressed hairs only). The following are representative:

Nay., E of San Blas (*Clarke et al. 1669-2*; in *Orbignya* forest, *Norris & Taranto 13397*); "Tepic" (*Beechey*, K!); Mpio. Tepic, km 20–30 on road to El Cuarenteño and Jalcocotán (*Téllez 11147*); "2–9 mi" W of Jalcocotán, road to Miramar (*McVaugh & Koelz 685*, in part); near Miramar, ca 1 km from the beach, roadside weed (*Feddema 957*); "ca 1.5 mi" W of Mazatán, on the old [1959] road to Las Varas (*Feddema 1120*); above La Cucaracha, "12–14 mi" S of Las Varas (*McVaugh 19241*); Mpio. Tecuala, campo experimental "El Macho" (*A. Rodríguez C. s.n.*, IBUG); Jal., Mpio. V. Purificación, Jirosto, Cerro de la Mina, 650 m in oak forest (*Domitila de Niz et al. 62*, IBUG); Mpio. La Huerta, campos experimentales de la Esc. de Agricultura, weed in cultivated lands (*Carvajal 767* in 1978, *Ornelas U. 166* in 1981, both IBUG); [seaward-facing slopes], "semi-evergreen forest ca 20 mi" SW of Autlán (*Webster & Breckon 16061*); road to La Huertita, 1.5 km SSE of Casimiro Castillo, 350 m (*Pérez de la Rosa s.n.*, IBUG); Mpio. Tuxpan, barranca W of Atenquique (*Rzedowski 21908*, juvenile apparently this form); Col., Colima (*Palmer 125* in 1897; Hda. Albarradita, 1 km W of Cd. Colima, *Gilly et al. 38*); Mpio. Comala, 22 km NNW of Cd. Colima, Rancho El Jabalí, road to Lago Calabozo (*Rothschild 022*); Mich., Aquila, 250 m (*Hinton 16030*, K, MICH); Coalcomán, 1000 m (*Hinton 12201*, K). (All specimens at MICH except as noted).

Another variant, perhaps of some taxonomic significance but insufficiently known, is one in which the teeth of the ♀ bracts end in narrow subulate tips 1.5–2 mm long, longer than the triangular proximal portion of the tooth:

Jal., Mpio. Pihuamo, 700 m, in tall valley-forest "3 mi" N of Pihuamo, with *Cecropia, Tabebuia, Ficus, Bumelia*, in deep shade (*McVaugh & Koelz 1417*, MICH); Mpio. Tecalitlán, ca 15 km E of Pihuamo, Sierra de los Corales, barranca San Juan de Dios, 1200–1300 m, in shade near the river (*Feddema 2141*, MICH); Col., Mpio. Coquimatlán, barranca Alcaparrosa, 15 km NW of Pueblo Juárez, 500 m, in subdeciduous forest with *Brosimum* (*Santana & Cervantes 944*, IBUG).

**Acalypha neomexicana** Muell. Arg. Linnaea 34: 19. 1865; in DC. Prodr. 15, pt. 2: 874. 1866.

In typical form a characteristic plant of moist shaded conditions in mountains and uplands from western Texas to Arizona, south into Mexico as far as southern Zacatecas, Aguascalientes, and northern Jalisco. A rather distinctive variety, here noted for the first time, is common in central and south-central Jalisco and adjacent Michoacán.

1. Branchlets and petioles rather densely puberulent with mostly curved hairs, at least the distal portions of the petioles also bearing numerous gland-tipped hairs; ♀ bracts slenderly glandular-pilose and hispidulous abaxially, with many glistening eglandular hairs 0.2–0.5 mm long and usually also with some larger hairs 1–2 (–3) mm long especially near the tips of the teeth; inner (adaxial) surfaces of the bracts with short hairs on the teeth and at their bases, but longer hairs and glands usually wanting; teeth of the ♀ bracts (7–) 9–10, all alike and triangular, 0. 6–1.2 mm long, or the central one deltoid (as wide as long), or somewhat longer than the rest, up to 2 mm long, 1.5–1.7 mm wide at base. *A. neomexicana* var. *jaliscana*.
1. Branchlets and petioles sparingly to moderately puberulent with mostly curved hairs, the petioles essentially without gland-tipped hairs; ♀ bracts mostly sparingly hispidulous abaxially, all or most hairs ca 0.5 mm long or less; gland-tipped hairs (if any) essentially marginal, the inner surface of the bracts sparingly hispidulous (not glandular) on the teeth only; teeth of the bracts (5–) 8–12, mostly ca 0.6–1.2 mm long, but the whole tip of the bract often prolonged, and the central tooth notably prolonged, up to 3–3.5 mm long, often 2–3 times as long as the lateral teeth. *A. neomexicana* var. *neomexicana*.

**Acalypha neomexicana** var. **jaliscana** McVaugh, var. nov., a var. *neomexicana* differt ramulis petiolisque dense puberulis, petiolis saltem distaliter glanduloso-pilosis, bracteis ♀ abaxiale glanduloso-pilosis hispidulisque, bractearum dentibus plusminusve aequalibus, dente centrali haud vel interdum vix prolongato. *Acalypha salvadorensis* Standl. J. Washington Acad. Sci. 14: 96. 1924, saltem quoad plantas mexicanas.

Ravines, shady slopes, grasslands, oak forest, tropical deciduous forest with *Bursera*, *Eysenhardtia*, *Heliocarpus*, grazed pastures with *Acacia*, moist places in cultivated fields and orchards, and borders of irrigation canals, roadsides, 1200–1850 m, mostly in the interior basins and the upper basin of the Río Santiago, flowering Sep–Nov.

Jal., Mich. (Mpio. Cojumatlán, near km 543, steep rocky slopes above Lake Chapala, ca "8 mi" NW of Sahuayo (*McVaugh 18162*, MICH, the holotype). The type of *A. salvadorensis* was from San Salvador (*Calderón 1741*, US, the holotype).

Jal., "about rocks in ungrazed grassland," "2 mi" NW of Tequila (*McVaugh 18620*, MICH); Mpio. Hostotipaquillo, Tequesquite (*Prado Aguilar s.n.*, IBUG); Mpio. Antonio Escobedo, "El Cerrito" in the town (*Olivia Montes F. s.n.*, IBUG); potrero La Higuerita, S of Ameca (*Sánchez Ramos 2*, IBUG); Mpio. Cuquío, Rancho S. José de Buena Vista, NE of Ixtlahuacán del Río (*Sánchez Sánchez 18*, IBUG); Mpio. Tala, La Primavera, pine plantation on University land (*A. Rodríguez & Reynoso 1574*, IBUG); Guadalajara [probably in the barranca of the Río Santiago], 24 Nov 1930 (*M. E. Jones 27466*, US; *Jones s.n.*, same date and place, MICH); Mpios. Guadalajara, Tlaquepaque, Zapopan (*many collectors*); Mpio. Villa Obregón, cañada del Rancho El Salto (*Puga 8952*, IBUG); Tototlán, on a *cerro* (*Covarrubias L. 6*, IBUG); Mpio. Jesús María, Rancho Paso de Guadalupe (*Olazaba Becerra s.n.*, IBUG); Mpio. Tlajomulco, in the settlement of San Sebastián el Alto (*Lepe Becerra s.n.*, IBUG); Mpio. Ixtlahuacán de los Membrillos, near Río Lerma, 20 km S of Atequiza (*Puga & Carvajal 14307*, IBUG); in an orchard N of Villa Corona (*Mendoza M. s.n.*, IBUG); Mpio. not ascertained, 1 km from La Mora, 1300 m (*Reyes Rosales 3*, IBUG); Mpio. Tenamaxtlán, Aguatitlán, 15 km S of Tenamaxtlán (*Soltero Quintana 3*, IBUG); mountains N of Autlán, "3–5 mi" above Mina San Francisco (*McVaugh 19689*, MICH); before las Canoas, outlying spurs (*estribaciones*) of the Nevado de Colima, 1800 m (*Santana Michel 1365*, IBUG); Mich., Mpio. Briseñas, Ibarra (*Avalos Trujillo*, "Gpo. A," IBUG).

Annual from a slender taproot, erect, (10–) 30–60 (–80) cm tall, noticeably soft-pubescent, the branchlets rather densely crisp-puberulent with mostly incurved hairs, a few short gland-tipped hairs intermingled; petioles similarly vestite, but

with more numerous gland-tipped hairs, these usually plentiful near the blade; stipules scarious, caducous, subulate or triangular, 0.5–1.2 mm long; petioles long and slender, (1.5–) 3–6.5 cm long, in well-grown plants often about as long as the blades; blades ovate, (2–) 4–7 cm long, up to 4 cm wide, blunt-pointed to acute or acuminate, rounded at base, the margins rather coarsely dentate; both surfaces hispidulous on the veins and, especially on the adaxial surfaces, on the lamina, commonly hispidulous and with some gland-tipped hairs on and near the margins; ♀ spikes terminal on the stem and branches, the central one largest, 3–6 (–12) cm long with up to ca 50 conspicuously leafy 1–2-flowered bracts, these suborbicular to flabellate or wider, 4–8 (–12) mm long, 8–12 (–15) mm wide, slenderly glandular-pilose on the outer (abaxial) surface and there also hispidulous with many straight glistening eglandular hairs 0.2–0.5 mm long, as well as (usually) scattered larger straight hairs 1–2 (–3) mm long especially on the margins and at the tips of the teeth; inner surface of the bracts commonly hispidulous on the teeth and below their bases, and often bearing gland-tipped hairs and scattered long straight hairs; teeth of the ♀ bracts (7–) 9–10, all alike and triangular, 0.6–1.2 mm long, or the central one wider, deltoid, the same length or somewhat prolonged up to 2 (–2.5) mm long, 1.2–1.5 mm wide at base, but the bract as a whole seldom notably prolonged at apex; ♂ spikes inconspicuous, 3–6 mm long including a short peduncle, axillary, arising at the bases of the ♀ spikes and commonly from the same axils; styles pale, laciniate, 2.5–4 mm long; capsule 3-lobed, oblate, 1.7–2 mm wide, short-setose, weakly fleshy-tuberculate; seed ovoid, plump, 1.2–1.3 mm long, 0.9 mm wide, gray or reddish, coarsely (for this genus) concave-reticulate, the individual areolae up to 0.1 mm wide or more.

Although this plant differs markedly from *Acalypha neomexicana* in geographical range, in abundance and quality of the vestiture, and in general appearance, it is so similar to that species in most qualitative characters that a close relationship between the two taxa seems certain. Particularly striking is the "excavato-foveolato-puncticulate" surface of the seeds, a feature (as long ago noted by Mueller) that sets *A. neomexicana* apart from all other herbaceous annual Mexican species of the genus. In another weedy species of similar aspect, *Acalypha indica*, the seeds are essentially smooth, with very fine cellular reticulations. The var. *jaliscana* may be much more abundant and widely distributed than is now known. It was long known only from about four Mexican specimens collected prior to 1961. Not until the collectors of the Instituto de Botánica (Universidad de Guadalajara) began an intensive program of exploration in Jalisco in the 1970s did its abundance there become apparent.

**Acalypha neomexicana** var. **neomexicana**. *Acalypha neomexicana* Muell. Arg., as to type.

Meadows and seeps, grassy openings, canyons and dry woodlands, oak forest, often in partial shade, 1200–2500 m, flowering Aug–Nov.

S w U. S. ("Novo Mexico," *Wright 1817, 1818*, syntypes; *Wright 1817*, G!, was named lectotype by G. L. Webster in 1964); Son., Sin., Chih., Dgo., Zac., Ags., Gto., Jal., Mich., S. L. P., Coah.

**Acalypha vallartae** McVaugh, sp. nov., *Acalyphae microphyllae* similis, sed foliorum laminis longe acutis non abrupte acuminatis; spicis ♀ linearibus, 3–4.5 mm diametro [non oblongis vel ellipsoidalibus 4–7 (–10) mm diametro]; pedunculis ♀ 15–25 mm long (plerumque ca 20 mm) [non 2–12 (–20) mm, plerumque ca 8 mm]; bracteis ♀ minute hispidulis strigulosisve, sine pilis rigidis longis conspicuis, differt.

Deciduous woodlands, borders of subdeciduous forest, coastal thickets and rocky slopes facing the ocean, always near the Pacific ocean but above the coastal sands, 2–30 m, flowering and fruiting Oct–Mar as far as known.

S Nay., Jal., where known only from coastal areas, Mpios. Puerto Vallarta and Tomatlán (vicinity of Los Arcos, "3.5 mi" S of Río de Cuale in Puerto Vallarta (*Webster & Breckon 15797*, MICH, sheet 1, the holotype; MEXU, isotype!).

Nay., Mpio. Compostela (2 km S of Lo de Marcos, Playa Vendados, "selva mediana, secundaria," *Téllez 12726*, MEXU; Pátzcuaro, en un arroyo, *S. Martínez 1023*, IBUG, MEXU); Mpio. Puerto Vallarta, on slope in slide area S of Playa Los Muertos (*Carter & Chisaki 1190*); "2.5 mi" S of Río de Cuale in Puerto Vallarta (*Webster & Breckon 15779*, MEXU, MICH); ca 2 km S of Puerto Vallarta, base of hills near rocks (*Feddema 2500*); s e shore of Bahía de Banderas, 9–12 km by road from [ca S of] Puerto Vallarta (*Anderson & Anderson 6037*); Mpio. Tomatlán, along Highway 200, "0.4 mi" N of the bridge at Playa Mismaloya, elev. 20 m (*Daniel 1079*). (All specimens at MICH except as noted).

Bushy annual or of indefinite duration (referred to by one collector as a "subshrub"), from a perennial multicipital taproot; stems mostly with several branches from the base, also branched above, 15–60 cm long, erect or sprawling; herbage sparsely fine-puberulent or the stems essentially glabrous, the leaves glabrous or puberulent on the veins or thinly strigose, the ♀ bracts minutely hispidulous or strigulose; stipules triangular or subulate, 0.3–1 (–3) mm long, caducous; petioles of major leaves very slender, 10–20 (–35) mm long; blades ovate, 1.5–3.5 (–7.5) cm long, 1–2 (–5) cm wide, acute at tip or (usually) prolonged distally, gradually acuminate from above the middle or (more often) from a broad rounded (rarely subcordate) base to a narrow tip; margins finely crenate-serrulate with 13–17 (–21) teeth on each edge, the rounded base of the blade entire; ♂ spikes axillary, when mature (20–) 30–70 mm long, 1.5–2 mm thick, the bracts not crowded on the axis, often separated by intervals about as long as the flowering unit, and more widely spaced toward the base of the spike; spikes much longer than the peduncles, these 5–15 (–30) mm long; ♀ spikes terminal and axillary, linear, at maturity 10–30 (–55) mm long, 3–4.5 mm thick (rarely –10 mm when pressed), often several together from approximate nodes at the tip of a branch, sometimes interrupted at base, often with a terminal seta terminated by a rudimentary ♀ bract and flower; peduncles filiform, 15–25 mm long; ♀ bracts (15–) 40–75, (1–) 1.5–2 mm long (–5 mm long in rare forms with a central prolonged tooth), when flattened flabelliform and ca 3 (–4)mm wide, ca 7-toothed, the teeth more or less triangular, up to ca 0.7–0.8 (–1.5) mm long, and at base about as wide (the 2 outer ones much smaller), acute or short-acuminate with cusp ca 0.2 (rarely –1) mm long; styles ca 6 mm long; capsule deeply 3–lobed, oblate, ca 1.5 mm in diameter, 1–1.2 mm high, distally verrucose and white-hispidulous with partly stellate or apparently dendritic hairs; seeds ovoid, acute, ca 0.8–0.9 mm long, nearly black, smooth, cellular-reticulate, with an oblique apical/adaxial crest.

This is perhaps the most distinctive of the segregates from the complex of *Acalypha microphylla*. It is contrasted with the varieties of that species in the key above, p. 181. It is unique in the combination of small, long-pointed (not abruptly acuminate) leaves, generally scanty pubescence, mostly short and relatively blunt and puberulent (not setose) ♀ bracts, and long-pedunculate and (for this group of species) slender ♀ spikes. It also appears to have a rather restricted habitat-preference, in its short known distribution along the coast of Jalisco and southern Nayarit. Almost all collectors have remarked upon the red color of the flowering spikes.

## ARGYTHAMNIA

In this paper and – according to present plans – in the *Flora Novo-Galiciana*, *Argythamnia* will be treated in the broad sense, as a genus comprising the three subgenera *Argythamnia*, *Chiropetalum*, and *Ditaxis*. John Ingram (1967, 1980) published revisions of the first two, but a modern revision of *Ditaxis* is much to be desired. Ingram (1980) argued that as the so-called genera have been separated almost exclusively on the characters of the ♂ flowers, and as these characters intergrade widely among species that have been assigned to one group or another, they are essentially useless as indicators of generic differences. Very recently, however, Webster (1994), in a general review of the classification of the Euphorbiaceae, recognized the same three groups as independent genera, separated in his opinion not only by characters of the petals but those of the styles, and most tellingly by those of the pollen grains.

The following key contrasts the taxa of subgenus *Ditaxis* that are known to occur in Nueva Galicia. It is presented in full here in order to place two newly described taxa in proper perspective. In both the stamens are usually 10, in two whorls; inflorescences essentially sessile, congested, subglomerate; seeds with small depressions, pitted-reticulate, or appearing irregularly tuberculate.

1. Upper whorl of stamens usually exserted from the inflorescence; staminodia 5, conspicuous at the apex of the staminal column, more or less erect, 0.7 mm long, evidently plumose; both ♂ and ♀ petals with ovate-sagittate blade and slender claw; seeds 2.1–2.5 mm long, reticulate-pitted, with flat-bottomed or shallowly crateriform bordered depressions; near the Pacific coast, sea-level to 200 m. *A. manzanilloana.*

1. Stamens not or only obscurely visible in the inflorescence; staminodia inconspicuous, usually 3 (sometimes apparently wanting), peglike or reduced to mere tubercles, glabrous; petals various, often narrowly lanceolate; seeds (2–) 2.5–2.8 (–3) mm long.
   2. Branchlets and both surfaces of the leaves rather sparingly beset with stiff coarse straight or slightly curved malpighiaceous hairs 1.5–2.5 mm long, the individual hairs mostly evident and distant except on growing tips; ♀ petals spatulate, 1–1.3 mm long; ♂ petals not adherent to the staminal column, seeming to arise between and alternating with the glands; lowlands of the Balsas depression, E to Oaxaca. *A. micrandra.*
   2. Branchlets and leaves not as above, the pubescence at least partly of soft flexuous to matted hairs, the straighter malpighiaceous hairs if present usually soft and flexuous, 1 (–1.5) mm long or less and the individual hairs not readily identified; ♀ petals narrowly lanceolate to ovate-lanceolate, narrowly long-acute, in ours 3.5–5.5 (–7) mm long; ♂ petals adherent to the staminal column at base, seeming to arise at the top of the glands.
      3. Entire plant gray, covered with crowded soft delicate flexuous hairs; leaf-blades subcoriaceous, broadly elliptic-ovate, 1.4–1.7 times as long as wide, abruptly and prominently short-acuminate, distinctly serrulate with ca 20 teeth on each edge; ♂ petals with ovate blade 2.3 mm long and a fleshy basal adaxial protuberance, abruptly contracted at base; staminodia apparently none; seed pitted-reticulate with mostly crateriform bordered depressions; Colima, Río Salado, 400 m. *A.* sp., aff. *A. discolor* Brandg.
      3. Plants gray or canescent when young, the stems and leaves at maturity commonly green but often densely pilose; leaf-blades various, in ours commonly twice as long as wide or longer, lance-ovate or ovate, gradually pointed, not abruptly acuminate, minutely denticulate but usually appearing entire to the unaided eye; ♂ petals in ours 4–5.5 mm long, lance-ovate to rhombic-ovate; staminodia commonly present; seeds various; widespread at middle elevations.
         4. Seeds pitted-reticulate, with distinct bordered depressions. *A. guatemalensis, sens. lat.*
         4. Seeds without obvious pits, the very shallow depressions without defined borders, covered with thick radiating striae that obscure the surface. *A. guatemalensis* var. *barrancana.*

**Argythamnia** ["*Argyrothamnia*"] **guatemalensis** Muell. Arg. Linnaea 34: 145. 1865; in DC. Prodr. 15, pt. 2: 736. 1866. *Ditaxis guatemalensis* (Muell. Arg. ) Pax & Hoffm. Pflanzenreich IV. 147. VI. [Heft 57]: 59. 1912. *Argythamnia guatemalensis* var. **guatemalensis** (*A. guatemalensis* Muell. Arg., as to type).

Primarily a central American species, the type (and type of var. *guatemalensis)* from "Guatemala" (*Friedrichsthal*, in herb. Lenormand, now at L ?, not seen). The species is well known and fairly uniform at low and middle elevations from Guatemala to Costa Rica, and ranges northwestward to Chiapas, Oaxaca, Morelos, and probably Puebla. A young flowering specimen from Colima (summits ca "11 mi" SSW of Colima on the Manzanillo road, 500 m, *McVaugh 18063*, MICH), may belong here but in the absence of seeds and of adequate flowering material I cannot be sure. Material from Veracruz and San Luis Potosí that has been called *A. guatemalensis*, as far as I have observed it, appears to belong to a different though related taxon. A revision of the entire complex would be desirable. The Central American form in the strict sense appears not to have been collected in Nueva Galicia, though scattered collections have been referred to it. In our area *Argythamnia guatemalensis*, *sensu lato*, is not likely to be confused with any other species of the genus except *A. manzanilloana*, which as far as known is confined to the Pacific lowlands.

P. C. Standley, who was well acquainted with the living plant in the field, described *Argythamnia (Ditaxis) guatemalensis* as an annual (Fl. Guatemala, Fieldiana Bot. 24, pt. 6: 88. 1949), but this is a somewhat misleading statement. It seems sometimes to flower the first year, when it has only a small taproot, but the plant is commonly described by collectors as a shrub or subshrub. I have seen seven collections of what I take to be *A. guatemalensis* (*sens. lat.*) from Nueva Galicia, and of these six were definitely described by the collectors as "shrubs" or "arbustos" 1–2 m tall, and the seventh as "sufruticosa de 1 m." Most herbarium specimens are woody at base, branched and with all appearances of a real shrub, often collected with portions of a thick attached woody root, and at least the older branches having a thin corky bark.

**Argythamnia guatemalensis** var. **barrancana** McVaugh, var. nov., a var. *guatemalensi* [*sensu Florae Guatemalae* et *sensu* Muell. Arg. in DC. Prodr. ] floribus majoribus seminibusque non distincte foveolatis, differt.

Steep slopes and barrancas, tropical deciduous forest with *Acacia*, *Bauhinia*, *Alvaradoa*, open grassy slopes with *Acacia*, *Croton*, *Wimmeria*, transition zone between *matorral* and forest with *Bursera*, *Jatropha*, and arborescent *Ipomoea*, sometimes in secondary forest, often in calcareous soils, 500–1500 m in the northern barranca-systems of the Santiago basin, flowering and fruiting Jun–Nov.

S Zac. ([Valley of the Río Juchipila], 20–21 km S of Jalpa, *McVaugh 23801*, MICH, the holotype), n Nay., n Jal., Qro.

Zac., "5 mi" NE of Jalpa (*McVaugh 18480*); Nay., Mpio. Nayar, along the river 500 m S of Jesús María (*Flores F. 1779*, without seeds but perhaps this variety); Mpio. Nayar, 2 km N of Rancho Viejo, road to San Juan Peyotán (*Tenorio 16328*, with immature seeds but perhaps this variety); Jal., "2 mi" N of San Cristóbal de la Barranca, [near jct. of Ríos Juchipila and Santiago] (*McVaugh 22145*). Apparently identical is a specimen from Querétaro, Mpio. Tolimán, 3 km S of Camargo (*Fernández N. 2884*, MEXU). (All specimens at MICH except as noted).

Shrub (or suffrutescent) with ascending branches, 1–2 m high; leaf-blades prevailingly ovate, sharply and narrowly acute or acuminate, subentire (obscurely

serrulate); bracts subtending ♂ flowers as far as known narrow and attenuate; ♂ sepals lance-attenuate, 4.5–5.5 mm long, 0.8–1.4 mm wide; ♂ petals narrowly rhombic-ovate, 4–5.5 mm long, the blade 1–1.8 mm wide, contracted to a substipitate base; ♀ sepals linear-acute or linear-attenuate, 4.5–7 mm long, 1.2–1.7 mm wide; ♀ petals narrowly lanceolate, 3.5–5.5 mm long, 0.7–1 mm wide; seeds without obvious pits, the very shallow depressions without defined borders, covered with thick radiating striae that obscure the surface.

A specimen from somewhat farther south than the locality near San Cristóbal de la Barranca, taken in the barranca of the Río Santiago (N of Guadalajara, "1.2 mi by road" above Puente Guadalupe, *Anderson & Anderson 5112*, MICH), has the acute ovate leaves and the attenuate ♂ bracts of var. *barrancana*, and the flowers are about as long as in that variety (the ♀ flowers even longer, with sepals 7–8 mm long, and petals 4.5–7 mm long), but the seeds are reticulate-foveolate, about as in the Central American race of *A. guatemalensis*.

## BERNARDIA

In 1961 (McVaugh 1961), in a synoptic account of the five species of *Bernardia* then known to me from Nueva Galicia, I noted that the Mexican species were not well understood taxonomically, for a variety of reasons. This is still true. Very little Mexican material was available 80 years ago at the time of the last general revision of the genus (Pax & Hoffmann 1914) and additional collections are still much needed. The casual collector may be deterred by the relative infrequency with which the plants occur, by the fact that most of our species are dioecious, most have very inconspicuous flowers, most species flower (often when leafless) in the dry winter and spring months when plant-collectors are least likely to be active, and most species occur in areas where high summer temperatures, heavy summer rains, rugged topography and tangled thorny vegetation combine to discourage the faint-hearted. Leafy ♀ specimens in fruit are almost impossible to associate with leafless ♂ material in flower. For many species ♂ material is unknown, or if specimens are known they are unidentifiable as to species.

The taxonomy of our species can hardly be well understood until an effort is made to secure adequate samples of both ♂ and ♀ material from the same populations at different times of year, including leafy and leafless, and flowering and fruiting, specimens from the same plants. Doubtless various hitherto unrecognized species will be found when more complete specimens are available. Fortunately, in Nueva Galicia most members of the genus may usually be recognized as such, even in the sterile condition, by the combination of stellate or fasciculate hairs and the presence of the characteristic annular glands (hereafter called "ring-glands") at the bases of the leaves. These glands, called "maculiform" by Pax & Hoffmann, and "cicatricoso-crateriform" by Croizat, are unique in the local Euphorbiaceae as far as I know.

It appears that a significant number of species (and perhaps of infraspecific taxa) of *Bernardia*, at least in our area, have very limited geographical ranges. One species that I described in 1961, *B. spongiosa*, has proven to be abundant in several localities in the Pacific lowlands, but the two other species described at the same time, *B. heteropilosa* and *B. wilburii*, seem to be still unknown except from the types. A very distinct species described below, *B. kochii*, seems to have been found but once, in spite of intensive exploration in the same general area over the

last decade. A second species described below, *B. santanae*, is known only from the foothills of the Sierra de Manantlán.

The following key contrasts and places in perspective all the species now known to me from Nueva Galicia.

1. Plants annual, monoecious; pubescence of simple hairs; seeds sharply trigonous; stamens 4–6; styles simple, deeply bifid, the branches subulate, entire or roughened on the adaxial face. *B. sidoides.*

1. Plants shrubs or small trees, dioecious (rarely monoecious in *B. santanae*); pubescence at least mostly of stellate or fasciculate hairs; seeds not trigonous, variously rounded, sometimes with a single sharp abaxio-apical keel; stamens commonly 10 17 (–38); styles flattened, recurved or spreading.
   2. Leaves thickly pilose-hispid adaxially with simple hairs. *B. heteropilosa.*
   2. Leaves (at least when young) finely stellate-pubescent or fasciculate-pubescent adaxially, sometimes with a few additional simple hairs.
      3. Petioles of major leaves 25–65 mm long, with a conspicuous abaxial brush of stiff erect whitish hairs 1–1.5 mm long extending from the distal end of the petiole onto the midvein, and a similar brush extending down the twig from the base of the petiole; stamens ca 35–38; styles bifid with thick linear blunt branches; seeds ellipsoid with rounded ends, 12–13 mm long. *B. kochii.*
      3. Petioles of major leaves (1–) 5–15 (–25) mm long, uniformly pubescent to nearly glabrous, without tufts of larger hairs at base and apex; stamens 15 or fewer; styles more or less lacinulate; seeds various, as far as known globose and 10–11 mm in diameter, or cordiform and 7–8 mm long or less.
         4. Leaf-blades 1.5–2.5 cm long on petioles 1–3 mm long, obovate, 1–1.7 cm wide near the blunt or rounded apex, the margins with 15–20 hairy-tufted teeth on each edge, these conspicuous chiefly across the distal margin of the blade; ♂ material unknown; immature fruit terminal, sessile and solitary, densely tomentose, the 3 styles thick, rigidly recurved, involute with jagged margins, attenuate to narrow toothed tips; n Jalisco only. *Bernardia* sp.
         4. Leaf-blades 3–10 (–22) cm long, 2–8.5 cm wide, the petioles mostly 5–15 mm long; blades lanceolate to ovate, elliptic or elliptic-obovate, with mostly acute or acuminate tips, the margins finely or coarsely toothed; fruit various.
            5. Carpels and styles usually 2; fruit globose, 2 cm in diameter, soft and spongy, indehiscent; styles with a terminal many-parted flabellate fringe 2–2.5 mm long; seeds hemispheric, 10–11 mm in diameter; flowers produced on leafless branches, or with the leaves; bracts of the ♂ aments 3 (–2)-flowered; pedicels of ♂ flowers 2–3 mm long; stamens 8–10 (–12); Pacific lowlands, 500 m or usually lower. *B. spongiosa.*
            5. Carpels and styles 3; fruit a woody and elastically dehiscent capsule, oblate, strongly 3-lobed, 0.7–1.5 cm wide; styles various, many-branched; seeds 4–8 mm long, cordiform; flowers produced on leafy branches or occasionally with immature leaves; bracts of ♂ aments (unknown in *B.wilburii)* (2–) 3- or 5- or mostly ca 10-flowered; ♂ flowers sessile or on pedicels up to 1.8 mm long; stamens (10–) 12–15; mostly species of the Pacific foothills, but ranging from sea-level to 1500 m.
               6. Major leaf-blades 20–22 cm long, prominently and sharply acuminate, primary lateral veins 7–9 (–12) on each side of the midrib, essentially equal, the basal pair often ascending more steeply than the others, but shorter and weaker in comparison, the blade not triplinerved; ♂ bracts ca (6–) 10-flowered, all but 2–3 flowers often aborting before opening; styles involute, ca 2 mm long, erect, each divided into 30 or more unequal subulate divisions. *B. santanae.*
               6. Major leaf-blades up to 10–13 cm long, acute or obtuse, seldom conspicuously acuminate; primary lateral veins 5–7 or fewer on each side of the midrib, the blades usually triplinerved at base and the lowermost veins commonly stronger than the others; ♂ bracts (unknown in *B. wilburii*) (2–) 3 5 (–6)-flowered; styles (probably involute) with recurved laciniate tips.
                  7. Abaxial surface of the leaf-blades copiously beset with pale minimally overlapping stellae, these with ca 5–8 rays 0.3–0.8 mm long; hairs of the

capsule 1 mm long or more, upstanding; seeds 7–8 mm long; ♂ material unknown; known only from the type-collection, "2 miles west" of Autlán. *B. wilburii.*

7. Abaxial surface of the leaf-blade thinly to densely beset with minute stellulae, or nearly glabrous with larger stellae on the principal veins, or in age essentially glabrous; capsule minutely stellulate, the rays of the hairs mostly 0.1–0.3 mm long; seeds 4–6.5 mm long.
   8. Abaxial surface except when very young with few stellae except on the larger veins, and tufts of pale hairs up to 0.5 mm long in the axils of the principal veins, these hairs considerably larger than the few superficial hairs and those on the veins above the axils; teeth of the blade commonly 2–4 (–6) per cm of margin; ♂ bracts (2–) 3-flowered; seeds 4–5.5 mm long. *B. gentryana.*
   8. Abaxial surface beset (usually very densely) with minute stellulae, often scurfy and whitened when young, often glabrescent in age, the axils of the principal veins with no tufts of longer hairs; teeth of the blades commonly 8–12 per cm of margin, sometimes fewer in old leaves; ♂ bracts (4–) 5 (–6)-flowered; seeds 5.5–6.5 mm long. *B. mexicana.*

**Bernardia kochii** McVaugh, sp.nov., frutex ut videtur dioicus, 3 m altus, juventute minute stellulato-pilosus, maturitate fere glaber; petiolus basi apiceque pilis creberrimis erectis 1–1.5 mm longis ornatus; folia petiolis 2–6.5 cm longis, laminis (8–) 12–18 cm longis, anguste acuminatis; ♂ inflorescencia grandiflora, 3.5–4.5 cm longa, bracteis 10–15 viridibus, deltoideis, 1 mm longis, (2–) 3–5-floris, floribus fere glabris, sparsim strigosis, sepalis 3, 3 mm longis, staminibus 35–38; spica ♀ 3 cm longa, 2–4-flora; ovarium strigosum, stylis 3, bifidis, ramulis linearibus obtusis integris; capsula 3-lobata, ca 1.5–1.7 cm longa, 2 cm lata, sparsissime strigosa; semina ellipsoidalia, laevia, 12–12 mm longa.

Known only from the type collection, Jalisco, Mpio. Zapotitlán, 11 km N of Hacienda San Antonio [Col. ], *brecha* to El Borbollón, 1600 m, common in mixed broadleaf forest, with flower and fruit 21 Apr 1990 (*J. Villa C., S. D. Koch & J. Chávez L. 702,* CHAPA, the holotype).

Shrub 3 m high, apparently dioecious; young herbage and inflorescences rather thinly beset with pale, mostly appressed, 2–3-rayed stellulae 0.1–0.2 mm long, or longer on the foliar veins abaxially; leaves and the smooth terete branches essentially glabrous at maturity, the leaves glabrous adaxially from the first except for lines of stellulae on the veins, the abaxial surface with longer and more numerous stellulae, also with a conspicuous brush of straight stiff erect whitish hairs 1–1.5 mm long, extending from near the distal end of the petiole along the midvein (sometimes for half the length of the blade), and a similar but smaller brush down the twig from the base of the petiole; stipules subulate, strigose, deciduous, up to 1–1.5 mm long; petioles stellulate (in age mostly glabrous) but without long hairs except at base and apex, relatively thick and stiff, 0.6–1 mm thick even in very young leaves, in major leaves 2.5–6.5 cm long, 1.5–1.8 mm thick; blades green, coriaceous, elliptic to lanceolate or oblanceolate, (8–) 12–18 cm long, 3.6–6.5 cm wide, narrowly acuminate, the whitish slightly thickened margins usually abruptly incurved at base and shortly decurrent on the petiole; ring-glands on the abaxial surface 1–3 on each side of the midrib; veins whitish and conspicuous, the lateral ones 5–ca 8 on each side without smaller intermediate veins except those connecting the principal pairs; margins pale, coarsely low-serrate, each edge with ca 13–25 low teeth with blunt and often incurved callus-tipped teeth; ♂ inflorescences 1 or more from the upper axils, spikelike, 3.5–4.5 cm long, 5–7 mm in diameter before

the flowers open (–10 mm or more afterward), on peduncles 7–10 mm long and 1 mm thick; spike interrupted, the bracts 10–15, green, rigid, deltoid, 1 mm long, 1.5 mm wide at base, (2–) 3–5-flowered; pedicels ca 1.3–1.5 mm long; buds suborbicular, apiculate, very thinly strigose, 1.8–2.3 mm in diameter; ♂ sepals 3, elliptic-ovate, apiculate, 3 mm long, 2–2.5 mm wide; stamens ca 35–38, the filaments (?pale reddish) 1.5–2 mm long; anthers didymous, ca 0.5 mm long; ♀ spike terminal, ca 3 cm long, 2–4-flowered, the axis slightly zigzag between flowers; bracts about as in the ♂ inflorescence, 1-flowered; ♀ flowers sessile, the sepals ca 4 (–5), green, broadly rotund, ca 1.5–1.8 mm long, 2 mm wide or more, ciliolate; disk apparently continuous, lobulate, ca 2 mm wide; ovary ellipsoid, ca 6 mm long and 4.5 mm wide, obtusely angled, thinly stellulate, the styles 3, thick, strigose, contiguous at base with deep sulci between them, ca 2–2.5 mm long, bifid about half their length with thick linear blunt branches, strongly recurved against the tip of the ovary; fruit (described as "2 cm diam.") with 3 low rounded lobes, almost smooth with few very scattered stellulae, probably ca 1.5–1.7 cm long (high), the persistent styles strigose, 2.5–3.5 mm long, 1 mm thick at base and evidently not united there; columella 13–14 mm long, thin-winged, dilated at apex and there 5–6 mm wide; seed brown, ellipsoid with rounded ends, brown, smooth with separable papery outer layer, 12–13 mm long, ca 9 mm wide, with small apical scar and inconspicuous adaxial line.

This species is remarkably different from any other *Bernardia* in our flora, by virtue of its nearly glabrous and long-petiolate leaves with their distinctive tufts of hair at base, by its large ♂ flowers with very numerous stamens, and by its bifid styles with entire branches.The type-collection of *B. kochii* was originally identified as *B. interrupta* (Schlecht.) Muell.Arg., a much more heavily vestite plant of the Atlantic slope of Mexico in which the styles are similarly branched.

**Bernardia santanae** McVaugh, sp. nov., frutex vel arbor parva, monoica vel ut videtur dioica *B. mexicanae* similis, sed maturitate glabriuscula, foliis longioribus usque ad 20–22 cm longis, 7–8.5 cm latis, valde acuminatis acutissimis, laminis non triplinerviis sed nervis primariis lateralibus subaequalibus utroque latere 7–9 (–11), bracteis ♂ ca (6–) 10-floris, floribus aperientibus plerumque 2–3, stylis suberectis ca 2 mm longis, basi 3 distinctis sed approximatis, utroque stylo irregulariter ca 30-fido.

Hillsides in humid tropical subdeciduous forest with *Brosimum*, *Hura*, *Annona*, *Randia*, *Cecropia*, or more open forest with *Astronium*, *Passiflora*, *Begonia*, *Centrosema*, 400–800 m in the foothills of the Pacific slope, flowering Feb–May as far as known.

Jal. (2 km SE of Casimiro Castillo, Cerro La Petaca, *Santana & Benz 5710* in 1992, ♂♀, WIS, the holotype; ZEA, isotype). Known only from this collection and the two following.

Jal., 1–4 km E of Casimiro Castillo (*Santana & L. Guzmán 3370* in 1988, ♂ & ♀, WIS, ZEA; Arroyo Tacubaya, *Cochrane, Wetter & Santana 11700* in 1989, ♀, DAV, WIS).

Shrub or small tree 2–7 m high, dioecious or (as in the type-collection) monoecious, ?evergreen with lustrous green leaves; young herbage and twigs, and inflorescences, densely beset with pale minutely scurfy-stellulate hairs, the leaves glabrescent, the blades at maturity essentially glabrous, usually slightly rough on the adaxial surface; stipules pale or whitish, strigose, rigid, appressed, subulate, thick (rounded) at base, rather tardily deciduous, 1.5–3 mm long; petioles thinly

scurfy, stout, straight, (6–) 10–14 mm long, cylindric, not or scarcely sulcate adaxially, seemingly prolonged onto the abaxial surface of the blade, where at once diminished in diameter; blades elliptic or oblanceolate, prominently and sharply acuminate, narrowed from the middle or above to an acute or abruptly rounded or subtruncate base, those of major cauline leaves up to 20–22 cm long and 7–8.5 cm wide, those on flowering branchlets mostly smaller, 8–15 cm long, 3–5 cm wide; margins uneven, appearing erose, antrorsely low-serrulate with 3–5 teeth per cm of margin, often with 1–2 smaller teeth between the larger ones; ring-glands 1–5 near the base of the blade on the adaxial surface, small, mostly ca 0.3 (–0.5) mm in diameter; occasional additional glands sometimes few and scattered on both surfaces; venation pale and conspicuous on both surfaces, pinnate, the lateral veins 7–9 (–12) on each side of the midvein, essentially equal, the basal pair often ascending more steeply than the others but shorter and weaker in comparison, the blade not triplinerved; ♂ spikes axillary, at anthesis 1–3 cm long, 3–4 mm in diameter, flexuous, the 10–20 bracts well separated on the axis; bracts ca (6–) 10-flowered (all but 2–3 of the buds usually aborting before opening), coriaceous, green, erect from the base, broadly deltoid-ovate or reniform-ovate, apiculate, 1.5–2 mm long, 2–2.5 mm wide, becoming cup-shaped, the lateral margins upcurving and infolding the buds; ♂ flowers nearly sessile, the sepals valvate, 3, elliptic, boat-shaped, ca 2 mm long, 1.5 mm wide; stamens 13 (two counts), the stout pinkish fleshy subulate filaments 1.5–1.8 mm long, inserted between and among small glands; anthers ca 0.4 mm long; ♀ spikes terminal (on separate branches in *Cochrane et al. 11700* and *Santana & Guzmán 3370*), flexuous, 1–3 cm long on stout peduncles 5–8 mm long; bracts 4–7, 1-flowered, soon reflexed by the pressure of the developing ovary; flowers sessile, the sepals 5, imbricate, coriaceous, pubescent on both surfaces, broadly ovate, acuminate, unequal, 3 mm long, 1.5–2 mm wide, in fruit scarcely larger; disk flat, obscurely 5-angled, 2 mm wide; ovary densely stellulate, deeply 3-lobed, ca 2.5 mm long and 3 mm wide, the styles forming an erect terminal brush ca 2 mm high; style of each carpel irregularly divided and subdivided into 30 or more subulate divisions of unequal lengths and thicknesses, the 3 groups seemingly tightly coherent but each distinct above a short pedestal-like base; capsule (not seen intact) stellulate-hispidulous, probably ca 6–7 mm high and 10 mm wide, deeply 3-lobed; columella ca 4 mm long, 3-angled, irregularly winged and dilated at apex; seeds cordiform, obscurely wrinkled, dull gray brown with lustrous chestnut-colored blotches, ca 6.5 mm long, abaxially keeled, ca 4 mm wide, 4.5 mm thick (radial measurement), somewhat flattened on the adaxial face and squared or with projecting shoulders at the truncate base.

The epithet is intended to honor Francisco J. Santana Michel, who was involved in all three of the original collections made in Jalisco. The species resembles *Bernardia mexicana* in many respects, but the leaves of *B. santanae* are distinctively different in shape, in texture and in venation, the pubescence is very much sparser, the ♂ flowers are almost twice as many in the axil of each bract.

**Bernardia** sp.

The plant so identified in the key above is a freely branched shrub that is apparently well adapted to a very dry habitat. It is known so far only from specimens with immature fruits, collected in the desert-like area in northern Jalisco, where many other species are identical with, or seem to have affinities with, desert-inhabiting species from farther north. Superficially similar specimens are

known from Durango, but I have never found one that matched our plant in detail, and in the absence of mature fruit and of all ♂ material, I cannot give the Jalisco plant a name.

Jal., Rancho Los Arroyos del Agua, 15 km NW of Huejuquilla El Alto, "matorral subtropical con elementos de matorral xerófilo, *Lycium minimum*, *Leucophyllum*, *Jatropha*," 1550 m, immature fruit 4 Aug 1990 (*A. Flores M. 1989*, MICH, WIS).

Young twigs, stipules, petioles, and to lesser extent the abaxial leaf-surfaces, whitened by a dense covering of somewhat upstanding hairs; petioles 1–3 mm long; blades 15–25 mm long, obovate, rounded or occasionally broadly pointed at apex, where 10–17 mm wide, the hairs of the abaxial surfaces overlapping, mostly 8–12-rayed stipitate or substipitate stellae, the rays mostly 0.4–0.8 mm long, or shorter on the principal veins; adaxial surface green, the stellae not overlapping; marginal teeth ca 15–20 on each edge, the teeth hairy-tufted, conspicuous chiefly across the rounded end of the blade; immature fruit terminal, sessile, solitary, ca 7 mm wide, 6 mm long, densely tomentose.

## CHAMAESYCE

**Chamaesyce salsuginosa** McVaugh, sp. nov., annua, erecta vel suberecta, caulibus (5–) 10–20 cm altis, ramis glabris vel interdum linea adaxiali puberula ornatis, foliis junioribus interdum pilosis; stipulae pallidae, membranaceae, laciniatae, divisionum apicibus plerumque albidis, filiformibus; foliorum laminae 5–9 mm longae, 2–4 mm latae, oblongae vel lanceolatae vel inferiores ellipticae, basi rotundatae vel subcordatae, parum inaequilaterales, apice abrupte acutae vel obtusae, marginibus dentibus minutis, interdum remotis vel obscuris munitis; cyathia solitaria vel 2–5, terminalia vel bracteata in axillis distalibus, pedunculis usque ad 1 mm longis; involucrum 0.5–1 mm longum, lobis 0.4 mm longis, triangularibus, laciniatis; glandulae minutae, appendicum superficie interiore erectae exstantes; appendices albidae vel roseae, parvi, rotundatae vel obovatae, interdum rudimentales; flores ♂ plerumque 4–5; styli ca 0.5 mm longi, bifidi; capsula glabra, trilobata, 1.5–1.8 mm longa, ca 1.7 mm lata, columella 1.2–1.5 mm longa; semina brunnea (fumosa vel lurida), ovoideo-quadrangularia, 1.1–1.3 mm longa, obscure rugosa vel alveolata, superficie micro-reticulata, cellulis lucentibus. Species *C. nutanti* similis, sed partibus pro parte maxima minoribus, seminibus brunneis non nigricantibus, habitatio salina differt. Fig. 1.

Wet saline meadows, salt-flats, and borders of pools, 1350–1500 m in the interior basins of Jalisco, apparently the same species in similar habitats in Michoacán and Guanajuato at 1750–1900 m, collected with flowers and fruit Aug–Oct (once in May).

Jal., Mpio. Villa Corona, wet pasture near Villa Corona (*Dieterle 3492*, MICH, the holotype); Mpio. Zacoalco de Torres (salt flats, road to Acatlán, ca "4.5 mi" from Zacoalco, *Dieterle 3463*, MICH; pastizal salino, La Playita, orilla de la Laguna de San Marcos, *Zamudio & Guevara 4217*, IEB); between Zacoalco and Sayula (*Puga 2971*, IBUG, IEB).

Slender diffusely branched erect annual (5–) 10–20 cm high, forking from near base to apex, glabrous, or some plants in a population with branchlets (or some of them) crisp-pubescent in an adaxial line, and the young leaves sparsely and softly pilose; stipules weakly glandular at base with an intrastipular line of small glands, distinct, or united at least near base into a whitish or pinkish membranous scale

FIG. 1. *Chamaesyce salsuginosa*. Habit, ×1; tip of flowering branch, ×5; cauline node, ×10; node with leaves showing venation, ×5 (all from *Dieterle 3463*); cyathium at anthesis, and the same laid open, both ×30; capsule, seed in 3 views, and columella after dehiscence of capsule, all ×15 (all from the holotype).

0.5–1 mm long, usually deeply cut or lobed, the divisions with prolonged filiform tips; petioles 0.5–0.7 (–1.2) mm long; blades at major nodes 5–9 mm long, 2–4 mm wide, oblong or lanceolate or at the lower nodes elliptic, at base rounded to subcordate, slightly inaequilateral and manifestly 3-nerved, at apex abruptly pointed or obtuse and finely but sometimes distantly or obscurely crenate-serrulate; leaves of the branches commonly narrower, and successively shorter distally, often entire, narrowly lanceolate to linear; distal internodes short, the bracteal leaves subtending solitary cyathia or small sessile clusters of 1–5 cyathia at the forks and in the axils; peduncles at major forks up to 1 mm long, others shorter; involucres funnelform or campanulate, 0.5–1 mm long exclusive of the glands, often reddish; lobes triangular, ca 0.4 mm long, laciniate-toothed, often about as long as the stipitate gland/appendage; glands transversely elliptic, folded, 0.2 mm long, to rotund, ca 0.1–0.2 mm in diameter, standing erect on the inner surface of the appendage; appendages white or pinkish, rotund or obovate (or sometimes a mere external rudiment), as seen from outside usually ca 0.3–0.5 mm long, surpassing the gland by about the width of the latter; ♂ flowers 4–5 (–?10); styles ca 0.5 mm long, bifid ca one-half to two-thirds their length, not or scarcely capitate; gynophore 1.3–1.5 (–2) mm long, straight or bent, usually not strongly recurved; capsule glabrous, deeply 3-lobed, 1.5–1.8 mm long, ca 1.7 mm wide; columella 1.2–1.5 mm long; seeds light brown to dusky medium brown, ovoid-quadrangular, 1.1–1.3 mm long, truncate or rounded at base, obliquely obtuse at apex, the abaxial faces convex, ca 0.6–0.7 mm wide, the adaxial faces flatter and a little narrower, separated by a prominent adaxial line; all faces dimpled or with obscure transverse ridges, the surface microreticulate with glistening cells.

Like *Chamaesyce feddemae* and *C. potosina*, this species appears to be closely akin to the more widespread *C. nutans*, and is separable from *C. nutans* by a suite of characters, none of which is individually completely exclusive. As far as known, *C. salsuginosa* is confined to moist saline soils of marshes and lake-borders; it is usually a much smaller plant than *C. nutans*, with smaller leaves, stipules usually with more prominent hair-tipped divisions and less conspicuous basal glands, slightly smaller flowering and fruiting structures, fewer ♂ flowers, and dusky brown (rather than blackish) seeds.

The color of the seeds of *C. salsuginosa*, once seen, is unmistakable, but it is difficult to describe. It is not a clear brown, not yellowish, not reddish like the color of the seeds of *C. hypericifolia*, but a dusky or smoky brown, sometimes seeming gray, but never black. The very similar seeds of *C. nutans* are almost invariably blackish, and often with a visible pattern of irregular pits, suggesting those of the seeds of *C. potosina* but far less distinct.

Pubescence in *Chamaesyce salsuginosa* appears to be even more variable than in *C. nutans* or in other species with which it may be confused. In the material from the interior basins of Jalisco, most plants are glabrous or essentially so, a seeming minority having the branchlets puberulent along an adaxial line and/or the young leaves sparingly pilose. In an ample series of specimens collected by Dr. J. Rzedowski from the saline borders of Lake Cuitzeo in north-central Michoacán, it seems that plants with glabrous and puberulent branchlets are more evenly distributed, and in two of the collections from Lake Cuitzeo (*Rzedowski 39206* and *40281*) the branchlets are softly pilose as well as unilaterally puberulent. In specimens from similar habitats from east-central Guanajuato, for which I am also indebted to Dr. Rzedowski, both glabrous and puberulent forms occur. I should refer all the following to *C. salsuginosa:*

Gto., 17 km S of Dolores Hidalgo, highway to San Miguel de Allende (*Rzedowski 41077*, puberulent); 9 km E of Yuriria, highway to Salvatierra (*Rzedowski 40955*, glabrous); Mpio. Salvatierra, near Cupareo (*Rzedowski 39812*, mostly glabrous); Mich., vicinity of Lake Cuitzeo (*Rzedowski 39191*, glabrous; *Rzedowski 40272*, glabrous or puberulent). (All specimens at MICH.)

The treatment of the next species was provided by Dr. Michael J. Huft, who some years ago recognized this very distinctive plant as an undescribed species, and has kindly agreed to publish his account here, in advance of the *Flora Novo-Galiciana.*

**Chamaesyce trialata** Huft, sp. nov., annua prostrata, caulibus supra linea puberula ornatis, cetera glabra; caules dorsiventraliter applanati, subalati; stipulae distinctae, subulatae, inferiores 0.7–1.2 (–1.7) mm longae; petioli 1–1.3 mm longi purpurei; laminae oblique elliptici-oblongae, foliorum majorum (3–) 5–7 mm longae, (1.5–) 3–4 mm latae, apice rotundatae, basi valde inaequilaterales hemicordatae, marginibus grosse serratis dentatisve; cyathia solitaria vel in ramis brevissimis lateralibus fasciculata; involucra campanulata atrorubra, glandulis exceptis 0.5–0.7 mm longa, lobis 5 inconspicuis, glandulis 4 atrorubris, transversim reniformibus ca 0.3–0.5 mm longis, appendicibus suborbicularibus vel ovalibus, integris, rubris, 0.4–0.6 mm latis, quam glandulis longioribus; flores ♂ ca 10; styli tenues, ca 0.5 mm longi, distincti, integri vel apice breviter bifidi; gynophorum quam involucrum longius; capsula exserta, recurvata, leviter trilobata, 1–1.3 mm longa, inter carpellos in quoque sinu ala longitudinale carnosa ad 0.2 mm lata instructa, carpellis tricostatis; columella ca 1 mm longa; semina ferruginea, 0.8–1 mm longa, subtrigona, angulosa, transversim 4–5-sulcata. Fig. 2.

Known only from two collections at middle or low elevations, probably both in disturbed habitats on calcareous substrata, flowering Sep.

Col., 8 km "E" [i.e., nearly S] of Cd. Colima, disused quarry along route 110 (*Burch 2790*, MO 2238588, the holotype); Gro., Mpio. Ometepec, Los Amates [R.R. station] near Iguala (*Pringle 13682*, CAS, F, MICH).

Annual, prostrate, forming a mat up to 20 cm in diameter, the stems purplish, strongly dorsiventrally flattened except near the base, the internodes up to 0.8–1.2 mm wide, their edges strongly wing-angled; plants entirely glabrous except for a sparse or dense strip of puberulence along the upper (adaxial) side of the internodes; stipules distinct, apparently fleshy, subulate, the upper pair mostly 0.5–0.7 mm long, the lower ones 0.7–1.2 (–1.7) mm long; petioles purplish, 1–1.3 mm long; blades obliquely elliptic-oblong, those of major leaves (3–) 5–7 mm long, (1.5–) 3–4 mm wide, 1.6–2 times as long as wide, green and often with a red central blotch, rounded at apex, strongly inaequilateral and hemicordate at base; margins coarsely serrate or dentate, usually with 5–7 prominent sharp or blunt to rounded teeth across the apex and additional teeth along the longer edge; cyathia solitary or in small clusters on congested lateral branches shorter than the leaves; involucres campanulate, dark red, 0.5–0.7 mm long exclusive of the glands, 0.5–0.7 mm wide below the glands, 0.7–1.2 (–1.5) mm across the appendages; lobes 5, dark in color, inconspicuous, triangular-subulate, ca 0.3–0.5 mm long; glands 4, dark red, ca 0.3–0.5 mm long, reniform with a conspicuous transverse (tangential) trough, commonly forming a nearly continuous ring at the margin of the involucre; appendages semicircular to oval, entire, red, 0.4–0.6 mm wide, in length exceeding the width of the gland by (0.2–) 0.3–0.5 mm; ♂ flowers ca 10, the bracteoles very narrow, fimbriate at apex, not plumose; styles slender, ca 0.5 mm long, free to the base, essentially entire and subcapitate or very shortly bifid at the tips; gynophore stout, ca 1 mm long, projecting about half its length from the involucre, strongly

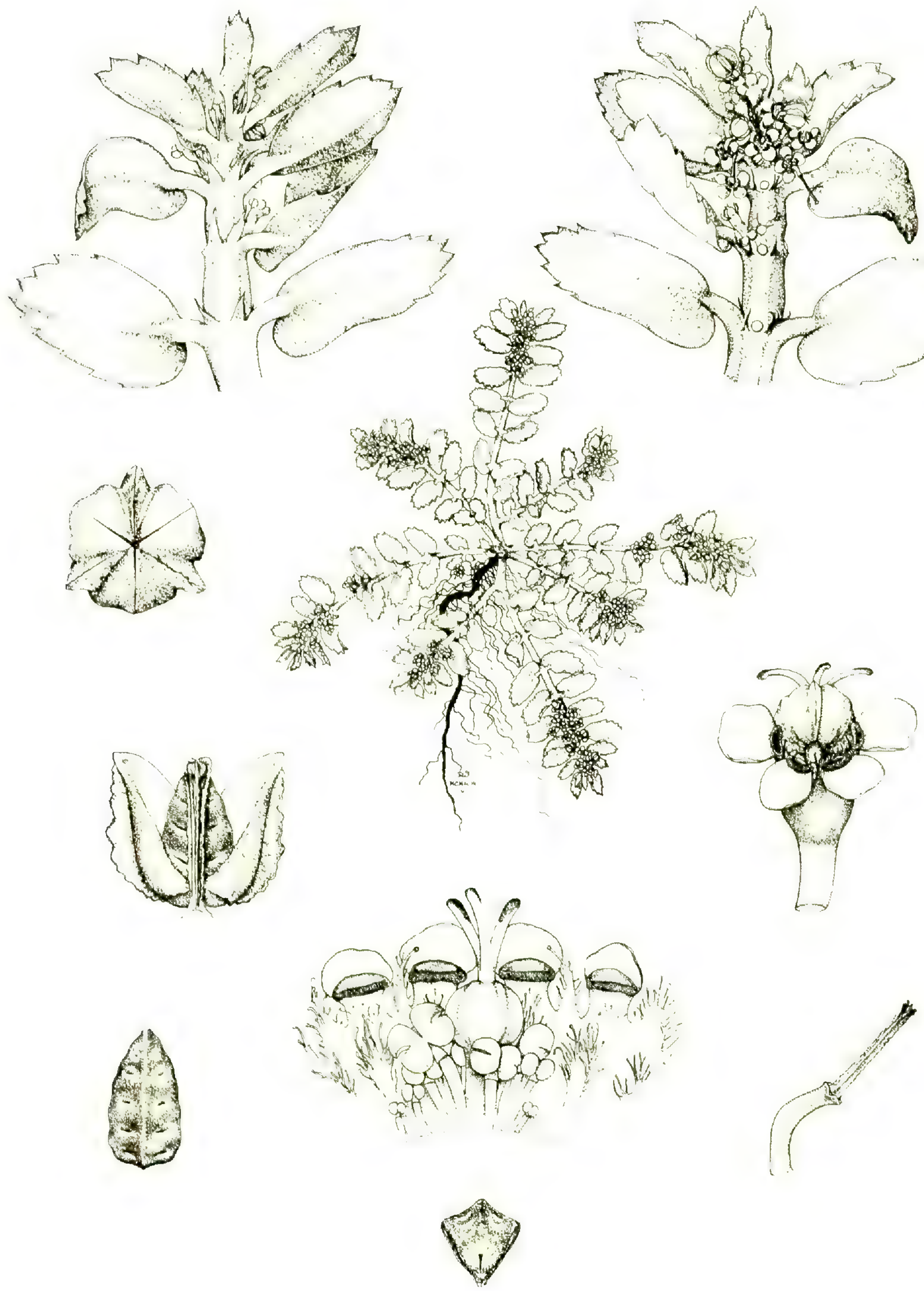

FIG. 2. *Chamaesyce trialata* (all from the holotype). Habit, ×1; tips of flowering branches from below (left) and above, ×5; involucre laid open, ×25; involucre with partly grown capsule extruded, ×15; capsule before dehiscence, basal view, ×20; seed in place in opening carpel, and seed in adaxial and apical views, ×20; columella after dehiscence of capsule, ×15.

recurved; capsules ovoid, 1–1.3 mm long, 1–1.2 mm wide, somewhat 3-lobed, with a fleshy longitudinal wing up to 0.2 mm wide, at or below the middle in each sinus between carpels, and each carpel longitudinally 3-ribbed; columella ca 1 mm long; seeds pinkish brown, 0.8–1 mm long, quadrate-ovoid (nearly trigonous in cross-section), with prominent keel-like lateral and abaxial angles, acute at apex, subtruncate at base, the abaxial faces subconcave, 0.3 mm wide, the adaxial ones nearly flat, 0.4–0.5 mm wide, separated by a narrow adaxial furrow; all faces transversely 4–5-sulcate, the furrows contracted to a mere line at bottom, the intervening ridges broad and round.

The very short crowded flowering branches appear to be lateral, but the persistent stub of an aborted terminal peduncle, indicating the dichasial nature of the branching, is usually present though somewhat laterally displaced, on the upper side of at least the distal nodes. The seeds are unusual in that the adaxial faces are wider than the abaxial ones, and the 3-ribbed carpels alternating with fleshy wings are unique among our species of *Chamaesyce*.

## CNIDOSCOLUS

The following species was recognized and named about 20 years ago by Dr. Gary J. Breckon, and the name has been used in some regional publications, but has never been validly published. Dr. Breckon has very kindly consented to publish it here, in anticipation of an extended treatment of this and other species in the *Flora Novo-Galiciana.*

**Cnidoscolus autlanensis** Breckon, sp. nov., arbor decidua 5–6 m alta, ramulorum medulla lamellata; pili stimulosi plerumque sparsi, usque 3–3.5 mm longi, pedunculi petiolique interdum pilis brunneolis stimulosis 1.5–3 mm longis dense ornati; glandula petiolaris non sessilis, lateraliter elevata, instar litterae C; folia (4–) 5-lobata, marginibus integris vel remote dentatis, venis majoribus in superficie abaxiali rufo-strigosis; flores ♂ 12–14 mm longi; stamina 10, filamentis superioribus 10–12 mm longis, inferioribus 4–4.5 mm longis antherisque in tubo profunde inclusis; flores ♀ 11.5–13 mm longi, perianthii lobis angustiusculis 2–3 mm latis, post anthesin secedentibus et seorsim deciduis; ovarium ovoideum subglabrum, non stimulosum, apice acuminato 1 mm longo, in fructu stylopodio persistenti rostriforme constanti; capsula ca 12–14 mm longa, rostrata; columella 10–11 mm longa; semina 10–11.5 mm longa, caruncula pallida, plerumque appressa, 1–1.5 mm longa, 1.5–2 mm lata.

Mexico: Jalisco and Colima, seaward-facing slopes, in open oak-dominated forests, mixed broad-leaved forest, or tropical deciduous forest with *Quercus*, *Croton*, *Ptelea*, *Heliocarpus*, (200–) 1200–1600 (–2000) m on the Pacific slope, flowering Jun–Aug. The type is from Jalisco, oak-dominated slopes facing the Pacific, "10 mi" S of Autlán, *Wilbur 2185*, MICH, the holotype; MEXU, WIS, isotypes), Col.

Jal., region of the type-locality (*McVaugh 14205*; *Wilbur 2154; Wilbur 1396*, MEXU, US); Mpio. Autlán, 2–3 km SW of Ahuacapán (*Cuevas & Núñez 3189*, WIS); Mpio. Zapotitlán, 24 km from San Antonio, Col., *brecha* to Las Moras (*Fuentes O. 389*); Col., gorge of Río Cihuatlán, near bridge "13 mi" N of Santiago, 200 m (*McVaugh 15802*, MEXU); Mpio. Comala, 5–6 km NW of Zacualpan, 5–7 km N of Campo Cuatro (*Cuevas & L. Guzmán 3937*, WIS); bluffs of Río Salado, "5 mi" S of Cd. Colima, 400 m (*McVaugh 15510*, MEXU). All specimens at MICH unless otherwise specified.

Deciduous tree 5–6 m tall, with short trunk up to 6–12 cm in diameter, the older bark brown; branches of the current year 5–10 mm in diameter; pith well-developed, lamellate; herbage thinly pubescent, moderately to scarcely at all stimulose, the stinging hairs mostly short, up to 3.5 mm long on the fruit, or the peduncles and sometimes petioles densely hispid with often brownish stinging hairs 1.5–3 mm long; stipules soon deciduous, 11–13 mm long, 3–5 mm wide, deltoid, few-toothed; petioles up to ca 30 cm long, appressed-tomentose near the apex; petiolar gland a fleshy C-shaped band borne laterally around the edge of a gland-platform, sometimes with additional adaxial orbicular glands; blades thin, (4–) 5-lobed, up to ca 30 cm long and 35 cm wide, the margins entire to remotely dentate, the major veins not strongly excurrent at the tips of the lobes; major veins reddish strigose abaxially; inflorescence a simple dichasium up to more than 30 cm long, forking 2–4 times; bracts 4–7 mm long; bracteoles 1.5–2 mm long, deltoid, greenish; ♂ flowers funnelform, 12–14 mm long, lobed one-fourth to more than one-third their length, the lobes 3–5 mm wide; buds clavate, typically constricted between the anther whorls when dry; stamens 10; upper filaments 10–12 mm long, those of the lower whorl 4–4.5 mm long, their anthers 2.5 mm long, deeply included in the tube and vertically appressed to the staminal column; disk 0.75 mm in diameter; ♀ flowers 11.5–13 mm long, narrowly campanulate, the lobes linear to narrowly obovate, 2–3 mm wide, at first shortly connate at base, separating after anthesis and in age falling separately; ovary ovoid, glabrous except for scattered striae, not stimulose, ca 3 mm long including the acuminate apex 1 mm long, this forming an abrupt beak in fruit; styles 5–6 mm long; capsule ellipsoid, when slightly immature 12–14 mm long, (8–) 11–12 mm in diameter, the apex with a pronounced abrupt beak developed from the stylopodium; columella 10–11 mm long; seeds 10–11.5 mm long, gray to brown, elliptic to obovate in outline, plano-convex with a low abaxial ridge, 5–6.7 mm wide, up to 3.9 mm thick, acute, cordate at base; caruncle dull yellow, smooth, small, often thin and tightly appressed, 1–1.5 mm long, 1.5–2 mm wide.

Species with which *Cnidoscolus autlanensis* may be confused locally include *C. tepiquensis* (Cost. & Gall.) McVaugh, which has much larger seeds (22–32 mm long), lower anthers 3.6–4.5 mm long, and connate perianth lobes in the ♀ flower. Another species that may be mistaken for *C. autlanensis* is *C. spinosus* Lundell, in which the ♀ sepals do not separate completely after anthesis, the stinging hairs are larger, the foliar veins lack the abaxial reddish hairs that characterize *C. autlanensis*, the petiolar glands are sessile, the seeds are smaller (ca 7.5–10 mm long), and the fruit lacks a stylopodium. In a little-known subspecies of *C. multilobus* (Pax) I. M. Johnst. that is reported from western Michoacán, both anther-whorls are exserted, the ovary is yellow-velvety, and the style-base is soon deciduous, not leaving a scar on the ovary.

## EUPHORBIA

The following species is included here with the permission of Dr. J. Rzedowski, who kindly loaned his unmounted specimens in order to facilitate the preparation of the drawing (our Fig. 3) that accompanies this account. It is a pleasure to associate with this interesting plant the name of its discoverer, the author of so many important and influential books and articles on Mexican plants.

**Euphorbia rzedowskii** McVaugh, sp. nov., subg. *Agalomatis* pertinens, annua, tenuis, 20–40 cm alta, diffuse ramosa, subglabra, cymulis involucrisque et ramulis

FIG. 3. *Euphorbia rzedowskii* (all from the holotype). Habit, ×0.5; portion of flowering and fruiting tip of a branch, ×5; cyathium, laid open, ×15; fruit, ×15, including distal portion of gynophore; seed, ×20; columella after fall of capsule, ×15.

junioribus sparse pilis brevibus debilibus paucicellularibus instructis; folia alterna, vel prope caulis basin minima, opposita, et sub inflorescentiae ramibus opposita; stipulae non visae; petioli filiformes, foliorum majorum ca 1–2 cm longi; laminae delicatulae, ellipticae vel ovatae, apice obtusae vel rotundatae, basi obtusae vel late acutae, integrae, foliorum majorum 0.8–1.8 cm longae, quam petioli plerumque breviores, subtus minute et irregulariter sphacelati; caules in parte superiore ramosi, furcati sed non dichotomi, cyathiis paucis in cymulis laxis apicalibus; pedunculi filiformes, usque ad 3.5 mm longi; bracteae foliaceae, 2–4 (–8) mm longae; involucra campanulata, extus strigosa, glandulis exceptis ca 1 mm longa; lobi inconspicui, triangulares; glandulae 5, transverse elongatae, 0.3–0.6 mm latae, appendicibus ut videtur albis, patentibus, late ovatis vel suborbicularibus, (0.5–) 0.7–1.2 mm longis latisque; flores ♂ ca 10; styli sub anthesi 0.6–0.7 mm long, erecti vel suberecti, fere ad basin bifidi; gynophorum capillare, post anthesin mox multum elongatum, usque ad 8–10 mm longum; capsula valde trilobata, diametro 1.5–2 mm; columella ca 1 mm longa, apicem versus late trialata; semina ovoidea, ecarunculata, ca 1 mm longa, foveis crateriformibus profundis satis grandibus conspicue obsitis, fovearum marginibus valde tuberculatis. Fig. 3.

Disturbed tropical deciduous forest on granitic hillsides, known only from the type-locality, Michoacán, 7 km W of La Huacana, on the road to Cuatro Caminos, elevation 500 m, with flowers and fruit 18 Oct 1975 (*Rzedowski 33682*, IEB, the holotype; MICH, isotype; *Rzedowski 33673*, IEB, MICH).

Slender delicate annual from a small taproot, openly branched with few ascending branches 5–15 cm long, forked repeatedly at the tips of the branches, the forks commonly asymmetrical but including the base of an aborted terminal pedicel (such a pedicel may appear at the base of what seems to be a lateral branch, above the middle of the stem); petioles exceptionally slender, but still mostly thicker than the capillary gynophores; blades very thin, most notable for the abaxial surface, this thickly and very irregularly beset with minute roundish or somewhat elongated or angular brown specks; cyathia as many as about 5 associated in loose clusters near the tips of the filiform branches; glands always 5 as far as known, slightly elevated above the surface, transversely furrowed at apex, usually wider (measured tangentially) than high, much surpassed by the white thin rotund appendages; styles pale, apparently whitish, linear, erect or the 6 divisions ascending-spreading from near the base, becoming ca 1 mm long in age; gynophore elongating soon after anthesis, at maturity greatly exceeding the involucre, straight or nearly so, not recurved, up to 8–10 mm long, remarkable for its extreme thinness; capsule probably a little wider than high, with 3 distinct rounded lobes; seeds ca 1 mm long, light gray or pale brown, ovoid, subtruncate at base, pitted over the entire surface with about 10–12 irregular longitudinal rows of more or less isodiametric and very deep crateriform pits, these conspicuously tuberculate on the margins at the angles between pits.

This species somewhat resembles *Euphorbia humayensis* Brandg., especially in the deeply pitted seeds. From *E. humayensis* it is at once distinguished by the lack of general glandularity of the branches, by the differently colored and larger appendages of the glands, and by the extremely long and slender gynophore.

## SEBASTIANIA

In our euphorbiaceous flora, the genera *Sapium*, *Sebastiania*, and *Stillingia* are separable without much difficulty if good fruiting material is available. The seeds of *Sapium*, with their red fleshy covering, are unmistakable, as are the

enlarged hornlike arms of the gynobase in *Stillingia*. *Sebastiania*, by default, is recognizable by not showing either of the above features. The identification of sterile or flowering material, or of specimens with immature fruit, may be more difficult, as the inflorescence is always a tight spike-like thyrse with one or few (or no) ♀ flowers at the base, and numerous ♂ flowers above, in bracteate few-flowered fascicles. In *Sebastiania* the stamens and sepals of the ♂ flowers are usually 3, whereas in *Sapium* and *Stillingia* the number is usually 2 of each, but this is not infallible. Some reliable features providing generic identifications are found in the leaves. Our representatives of *Sapium* are almost invariably identifiable by the prominent pair of oblong-cylindric or bluntly conic glands 1–2 mm long, which project laterally from the margins of the petiole just below the decurrent base of the blade. Among our species, most of the leaves and branchlets are opposite in the truly shrubby members of *Stillingia*, but not in *Sebastiania*. As far as I have observed, the paired glands at the base of the ♂ bracts provide the most reliable mean of separation of those two genera. In *Stillingia*, as in *Sapium*, these glands are simple and undivided, flat or patelliform or sometimes convex; in our shrubby species of *Sebastiania* (i.e., all except *S. corniculata)*, they are variously parted or faceted, with somewhat fleshy divisions that often shrink and become flattened upon drying and sometimes appear to be sunken beneath the two sides of the bract, then resembling a mosaic of small scales. In the first of the two species described below, they are commonly 5–8-parted, in the second 30- or more-parted.

**Sebastiania cornuta** McVaugh, sp. nov., arbor vel frutex arborescens, glaber, foliis spiraliter dispositis, viridibus, longipetiolatis, laminis juvenilibus arcte involutis; stipulae ovatae, supra basin membranaceae, 1.5–3 mm longae, basi 1.5 mm latae, marginibus fimbriatis; petioli 1.5–2.7 cm longi, involuti (teretes), glandulas geminatas (vel 3–5) annulatas planas vel patelliformes sub apicem adaxiale gerentes; laminae ellipticae vel elliptico-ovatae, 7–10 (–13) cm longae, 3–5 cm latae, planae (non revolutae), valde acuminatae, basi rotundatae vel interdum acutae non decurrentes, plerumque eglandulosae, marginibus pallide cartilagineis ad basin exceptis crenato-dentatis; inflorescentiae terminales spiciformes, floribus ♀ basilaribus 1–3, spicae parte distali multiflora; bracteae ♂ 5–10-florae, spiraliter dispositae; glandulae geminatae infra bractearum basin sitae, compositae, ex partibus 5–8 constantes; sepala ♂ 3, incurvata, late ovata, erosa, 1 mm longa; stamina 3, filamentis divergentibus 1 mm longis, pro parte tertia connatis; sepala ♀ imbricata 3, ovato-orbicularia, 2.5 mm longa; ovarium ellipsoidale teres (non trilobatum) 3–3.5 mm longum, 1.4–1.5 mm diametro, distaliter stylorum basi 1 mm diametro; styli 3–3.5 mm longi, vix connati, dorsiventraliter compressi, cornuti, basi abrupte patentes, 1 mm lati, 0.5 mm crassi, ad apicem curvatum gradatim angustati, marginibus stigmaticis crassis revolutis; capsula submatura late ovoidea, acuta non rostrata, ca 15 mm longa, matura non visa. Fig. 4.

Ravines in dry tropical deciduous forest, 600–1700 m (970 m as known in the northern part of the Santiago basin), mostly in the Sierra Madre Occidental, flowering Apr–Jul.

S Son., Chih., Dgo. (Mpio. Otaez, Otaez, frente al Rancho La Lechuguilla, 1270–1700 m, steep slopes in tropical deciduous forest with columnar cacti, *E. Guízar N. 2347*, MEXU, the holotype), n Nay.

Nay., Mpio. Nayar, 12 km W of Jesús María, road to Mesa del Nayar, not yet in flower Sep 28 (*Flores F. 1520*, DAV!, MEXU); 19 km SW of Jesús María (*Flores F. 2129*).

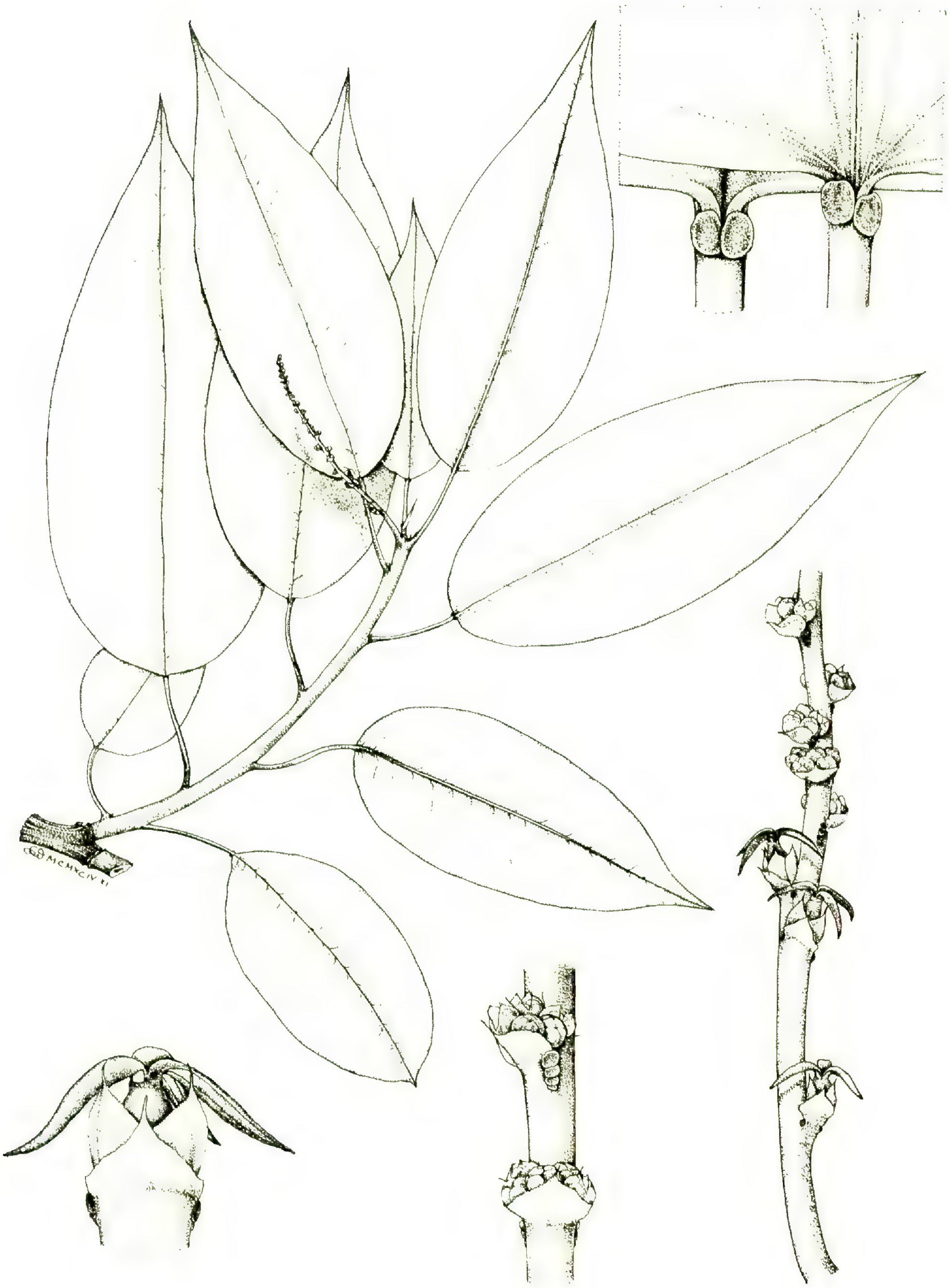

FIG. 4. *Sebastiania cornuta* (all from *Flores F. 2129*). Flowering branch, ×0.5; two leaf-bases showing paired petiolar glands, ×5; inflorescence, ×2.5; portion of inflorescence, ×5, showing bracts, faceted gland at base of bract, and several ♂ flowers in each bract; ♀ flower, ×5, showing bract and comparatively large sepals.

Chih., Mpio. Batopilas, along Río Batopilas between La Junta and La Bufa (*Bye 3541*, MEXU); between La Bufa and Batopilas (*Bye 3959*, MEXU).

Tree or treelike shrub 2–6 m high, glabrous, the young stems thinly pale-scurfy with an evanescent waxlike layer; leaves spirally arranged, in development tightly involute; stipules ovate (sometimes asymmetrical), papery above the thickened base, dark in color, erose-margined, acute, 1.5–3 mm long, 1.5 mm wide at base, the margins delicately membranous and fimbriate; petioles 1.5–2.7 cm long, tightly involute; blades elliptic to elliptic-ovate, 7.5–10 (–13) cm long, 3–5 cm wide, 2–2.5 (–3.3) times as long as wide, strongly acuminate at apex, rounded or occasionally acute at base, not decurrent onto the petiole, the margins pale-cartilaginous, not revolute, shallowly crenate-dentate or -serrulate, with 30–35 teeth along each edge except near the base; foliar glands none, or rarely solitary, patelliform, on the margin near base; petiolar glands mostly 2, adaxial, annular, flat or shallowly patelliform, paired (collateral) and appressed immediately below the junction with the blade, ca 1–1.3 mm long, the two together 1.5–1.7 mm wide, or often 2 pairs (one above the other) or with a third gland on one side, or sometimes united into a single gland; inflorescences terminal, spiciform, up to at least 6.5 cm long, the peduncle below the proximal ♀ flower ca 5 mm long; ♂ portion up to ca 6 cm long, very slender, erect, loosely flowered, ca 3.5 mm thick, the 30–35 ♂ bracts spirally arranged, 1.5–3 mm apart on the axis, ca ?5–10-flowered, membranous, reniform, 2–2.3 mm wide, 0.7–1 mm high, obtuse, or sometimes ovate and cuspidate; glands paired beneath the bracts with a strong decurrent ridge between them, compound with 5–8 facets (units), the whole 0.7–1 mm long, somewhat triangular, widest distally, often with 2 collateral units there, and a single unit wide below; ♂ flowers on pedicels ca 0.4–0.5 mm long, the sepals 3, broadly ovate, membranous, erose-margined, 1 mm long, alternate with the filaments and incurved between them; stamens 3, the filaments divergent, ca 1 mm long, connivent ca one-third their length; anthers very broad, 0.4–0.5 mm long, 0.6–0.7 mm wide, the thecae plump, divergent from apex toward base; ♀ bracts like the ♂ but larger, their glands similar, suborbicular, ca 1 mm wide; ♀ flowers 1–3, the sepals 3, imbricate, ovate-orbicular, ca 2.5 mm long, 2 mm wide, erose-margined, apiculate, not long-pointed; ovary ellipsoid, terete (not lobed), 3–3.5 mm long, 1.4–1.5 mm in diameter, ca 1 mm in diameter distally at the bases of the styles, these abruptly laterally spreading from the base without any perceptible column, 3–3.5 mm long, cornute, dorsiventrally compressed, ca 1 mm wide and 0.5 mm thick at base, tapering to the slightly upcurved tips, the rough stigmatic margins revolute, brownish; nearly mature fruit broadly ovoid, ca 15 mm long and 13 mm wide at base, tapering to an acute (not prolonged nor beak-like) tip, the tightly outcurved styles subpersistent, the capsule seemingly leaf-opposed on a divergent peduncle 3–5 mm long; columella, mature fruit, and seeds not seen.

It seems probable that in this species, as in *Sebastiania lottiae*, the spikes are always terminal, but the capsule in age may appear to be lateral and leaf-opposed if an axillary bud at the base of the ♀ flower develops into a leafy branch and displaces the ♀ peduncle laterally after the fall of the ♂ part of the spike. The leaf of *Sebastiania cornuta*, with non-decurrent blade, and large adaxial petiolar glands, is distinctive, much suggesting the leaf of *Hippomane mancinella*.

The specimen from Nayarit (*Flores F. 1520*) was once identified with *Sapium appendiculatum* (Muell. Arg.) Pax & Hoffm., but that appears to have been an error. The holotype of *S. appendiculatum* (*Stillingia appendiculata* Muell. Arg.) is in G-DC!, with printed label "Nueva España. Herb. Pavon," and a contemporary

Sessé & Mociño label with the name "Hippomane glandulosa" in printed and written versions. At G in 1993 I could find nothing like it from Nueva Galicia. In its decurrent leaf-margins and the want of large patelliform paired petiolar glands, it is very unlike *Sebastiania cornuta*.

In the "Pavón" specimen the stipules are triangular-falcate, 1.3 mm long, glandular above the base. The petioles are 0.5–1 cm long; the blades are elliptic to obovate, 3–6 cm long, 1.7–3.5 cm wide, as long as wide or up to ca twice as long as wide, as base rounded to acute and definitely but shortly decurrent on the petiole; the margins are serrulate with ca 50 sharp saw-teeth on each edge, often including 2 thicker gland-teeth as the lowest pair on the decurrent base, and often with 1–3 small blunt gland-teeth scattered along each edge; glands of the ♂ bracts simple, flat, ca 2 mm long; free style-tips subulate or laterally flattened; style-column as long as the ovary.

**Sebastiania lottiae** McVaugh, sp. nov., arbor mediocris, glabra, ramulis hornotinis e bracteis subligneis imbricatis amentaceis oriundis; folia longipetiolata, ambis superficiebus viridibus, plerumque eglandulosis, laminis elliptici-ovatis, apice basique plerumque subaequaliter acuminatis, marginibus (ad basin exceptis, vel in eo loco dentibus obscuris) minute crenato-serrulatis; inflorescentiae terminales coaetaneae, parte ♂ distali, bracteis ca 35 vel ultra, 5–6-floris; glandulae compositae, ex 30–35 partibus vel ultra constantes, sub bracteae basi oppositae sitae; sepala ♂ 3 (–2) oblonga vel anguste triangularia, usque ad 1 mm longa; stamina 3 (–2), fere distincta; flos ♀ basi spicae solitaria stylis 3 basi coalitis, sub anthesi haud elongatis, columna post anthesin (6–) 8–9 mm longa, stylorum partibus liberis (5–) 7.5–9 mm long, ascendentibus non valde spiraliter curvatis, basi crassis, ad apicem gradatim angustatis; capsula perlignoa, valde rostrata, rostro incluso (8–) 10–14 mm longa; semina 6–6.5 mm longa, (6–) 6.5–7 mm lata; caruncula non visa. *Sebastiania* cf. *hintonii*, *sensu* Lott (1986, p. 34; 1993, p. 28), not *S. hintonii* Lundell.

Subdeciduous forest with *Ficus*, *Jacaratia*, *Guapira*, *Astronium*, *Coccoloba*, *Esenbeckia*, *Erythroxylum*, *Tabebuia*, or second-growth deciduous forest with *Cordia*, *Ficus*, *Caesalpinia*, 60 mm or less on the Pacific coastal plains, collected once with ♀ flowers in July, and once with over-ripe capsules in August. In Guerrero flowers May–Jun.

Jal. (Mpio. La Huerta, Estación Biológica Chamela, Arroyo Colorado, *Ayala & Lott 37*, with ♀ fls 9 Jul, MICH, the holotype), Mich., Gro., Mor., Oax.

Jal., Mpio. La Huerta, Arroyo Chamela (*Magallanes 4407*, with fruit dehisced, and seed, MICH); Arroyo Colorado, E of Cerro Colorado (*Ayala 89*, young fr July, MEXU, MICH; *Lott 1766*, MEXU, MICH; *Magallanes 4383*, reported by Lott, 1993, not seen); Mpio. Cihuatlán, "5 mi" N of Bahía de Navidad (*McVaugh 20870*, MICH, sterile Nov., fr on ground presumably from the same tree). Emily Lott informs me that all the collections made by her and her associates at Chamela were taken from a single tree, the only one known.

Mich., Arroyo del Chivo ["Chibo"], sterile 30 Nov (*R. D. Bratz M675A*, MEXU); Gro., [Puente] Mexcala, 600 m, fl [photo] 6 Jun, imm fr 15 Jun (*Halbinger 281*, MEXU; imm fr 29 Jun, *Halbinger 281*, MEXU); Xochipala, old fr 4 Oct (*Halbinger s.n.*, MEXU); Mor., Cañón Lobo, 1500 m, young fl 7 Jun (*Halbinger 135*, MEXU); Oax., Mpio. San Juan Lajarcia, Distr. Yautepec, 8.8 km NW of La Reforma, road from Tehuantepec to Oaxaca, 570 m, imm fr 3 Jul (*R. Torres C. 9836*, MEXU).

Glabrous tree 5–12 m high and with trunk up to 30 cm in diameter; bark gray, when cut yellowish pink (?) (*mamey-rosado*); latex yellowish white, copious; branchlets often arising from the tips of ament-like clusters 5–15 mm long and 3–5 mm thick, these formed of broad rigid 3–5-ranked and long-persistent subwoody bracts, up to ca 15 in a rank; branchlets in drying shrinking, becoming fluted, reddish, with rather large scattered lenticels; stipules subpersistent, deltoid, thickish at base, 1–1.5 mm long and about as wide, with fragile scarious tip and broad whitish margins; petioles of major leaves 1–2 cm long, neatly channeled adaxially; petiolar glands wanting; foliar glands wanting or commonly 1–3 near the base of the blade on one or both sides of the petiole, saucer-shaped, round and 0.5–1.3 mm in diameter or elliptic, up to 2 mm long in the larger dimension, all sitting astride the edge of the blade and facing outward; blades of major leaves elliptic-ovate, 5–9 cm long, ca 1.5–3.5 cm wide, ca 2–2.7 (rarely –4) times as long as wide, with narrowly acuminate to caudate tip up to 1 (–2) cm long; base rounded, then acutely narrowed and prolonged, decurrent onto the petiole; margins finely but evidently crenate-serrulate except at the very base, the teeth with minute deciduous gland-tips; inflorescences produced with the developing leaves, terminal on young short branches, but mostly soon displaced laterally by growth of an axillary branch at their base and the solitary sessile ♀ flower (after the abscission of the ♂ axis and flowers) appearing pedunculate and leaf-opposed; ♀ flowers solitary (or 2), basal, the ♂ portion of the inflorescence distal, 2 (–?4) cm long, with up to 35 or more crowded spirally arranged 5–6-flowered bracts; bracts whitish, membranous, subclasping, ca 1–1.5 mm wide and 0.7–1 mm long, the margins undulate or erose-dentate, or prolonged centrally with a short median cusp; glands paired beneath the base of the bract (at its proximal edge) with a decurrent ridge between them, multi-faceted, in all up to ca 1 mm long and 0.7–1 mm wide, consisting of 30 or more quadrate or oblong units in ca 10 longitudinal rows of 4–5 each; ♂ flowers crowded, the abaxial and lateral ones sometimes with reduced numbers of sepals and stamens; calyx deeply 3 (–2)-cleft, the lobes oblong or narrowly triangular, up to 1 mm long; stamens 3 (–2), nearly sessile in bud, the anthers (then fully developed) plump, ca 0.7 mm long and about as wide, the two locules divergent from the apex downward; ♀ flower(s) sessile at anthesis, the subtending bract and glands like those of the ♂ flowers but the bract larger, clasping-triangular, at least 2 mm long including the central cusp; 2 smaller, lateral bracts (?bractlets) quadrate, less than 1 mm long and wide with a small glandular platelet on the side next to the axis, flanking the base of the calyx; sepals 3, imbricate, envolving the ovary, membranous or fleshy at base, ovate, acuminate, cuspidate, ca 2 mm long, 1.5 mm wide; ovary at anthesis 3-lobed, narrowed distally to a short isthmus, the thick base of the united styles; free parts of the styles somewhat spirally outcurved, fleshy, terete with an abaxial groove, gradually tapering to an acute tip, ca 2.5 mm long, 0.5 mm in diameter; ♀ flowers after anthesis, with enlarging ovary, seeming solitary and leaf-opposed on apparent peduncles 4.5–7 mm long, 0.7–1.3 mm thick; style thick, gradually dilated toward base, the column (6–) 8–9 mm long, the 3 branches entire, (5–) 7.5–9 mm long, thick at base, subulate, appressed-ascending (not strongly recurved), abaxially grooved, adaxially thickened and apparently fleshy, papillose-roughened; capsule very woody, dehiscent loculicidally and septicidally, long-beaked, (8–) 10–14 mm long including the beak; columella not seen entire, the tip greatly and abruptly dilated, with 3 short thick spreading to recurved radiating horns ca 1.7–2 mm long, alternating with 3 oblong spreading structures 3 mm long, which apparently terminate the wings of the

columella; seed (the color not known) smooth (at least without ornamentation), rounded on all sides but slightly compressed and evidently wider than long, 6–6.5 mm long, (6–) 6.5–7 mm wide, ca 5 mm thick, with two broad flat oblique apical/adaxial facets; caruncle not seen.

The above descriptions of both ♂ and ♀ flowers and inflorescences at the time of anthesis were taken from *Halbinger 135*, a specimen from Morelos. All the material cited above, including these flowering branches as well as fruiting or sterile specimens from Jalisco and elsewhere, is so much alike in all other characters that it surely all represents the same species-complex. It is possible that additional collections of good flowering and fruiting material will show that there are infraspecific taxa or even more than one species in the complex, but for the present I have no hesitation in treating our plant as conspecific with the others.

The long style-column and the many-faceted glands of the ♂ bracts are unlike those of any other species of *Sebastiania* in our flora. The resemblance between this plant and *Sebastiania hintonii*, with which it has been identified in the past, is in fact not very close except that the major leaves are about the same size, both long-petiolate, similarly dentate, and both with long-acuminate tips. The blades in *S. hintonii*, even after drying, are usually markedly glaucous beneath, not noticeably decurrent at base, with stipules elongate, thin and scarious and deciduous almost before they expand, and the foliar glands, if any, flat or short-cylindric. In *S. hintonii* the glands of the ♂ bracts have fewer and more prominently displayed facets, the styles are little more than 2 mm long, never with a prolonged column, divided half their length and with branches strongly recurved. The seeds are elongate, evidently longer than wide, with a flat conspicuous caruncle.

## STILLINGIA

The following key includes all the species of *Stillingia* known to me from Nueva Galicia.

1. Aerial stems mostly annual, herbaceous or subherbaceous, arising from an enlarged woody base, usually without lenticels; leaves and branches mostly alternate, sometimes subopposite or verticillate in the inflorescence; seeds 5.5–8 mm long including the caruncle.
   2. ♂ bracts 1-flowered; seeds 5.5–6 mm long; horns (lobes) of the gynobase 3–4.5 mm long, not upcurved-falcate but laterally spreading; free portions of styles 4.5–5 mm long; known only from Cerro Grande, SW of La Piedad. *S. pietatis.*
   2. ♂ bracts 3–5-flowered; seeds 7–8 mm long; horns (lobes) of the gynobase (3–) to 9 mm long, falcately upcurved; free portions of styles ca 2.5 mm long; uplands, widespread. *S. zelayensis.*
1. Plants shrubby, with slender perennial woody mostly opposite branches, often with some or many conspicuous lenticels, and opposite leaves; seeds 4–5 mm long including the caruncle.
   3. Petioles (3–) 6–9 mm long; blades 3–4.5 (–7.5) cm long, lanceolate with narrowly prolonged and subacuminate tips; large glands at junction of blade and petiole usually present, 0.5–1.3 mm long, 0.5–0.8 mm wide. *S. querceticola.*
   3. Petioles 0.5–1 (–1.5) mm long; blades (0.8–) 1.5–2.5 (–3.5) cm long, very narrowly elliptic or lanceolate, blunt or short-acute at apex; glands near base of blade usually wanting, if rarely present 0.1–0.3 mm wide. *S. sanguinolenta.*

**Stillingia pietatis** McVaugh, sp. nov. *S. zelayensi* ut videtur similis suffruticosa sed cymulis ♂ unifloris, calyce ♂ infundibuliformi compresso margine integro, partibus stylorum liberis 4.5–5 mm longis, foliis late ovatis valde acuminatis, petiolis brevioribus latioribusque, gynobasi sub columellam encrassata convexa, lobis non falcatis, lateraliter patentibus, differt. Fig. 5.

FIG. 5. *Stillingia pietatis* (all from an isotype, MICH). Flowering branch with young capsules, ×0.5; seed, ×3; bract in ♂ part of inflorescence, ×7.5, turned back in early anthesis showing solitary stipitate flower with 2 anthers extruded from the calyx; inflorescence at anthesis (lower right), ×2.5, with most ♂ flowers still in bud; inflorescence with nearly mature capsules and filiform persistent styles, ×1, the distal part of the ♂ spike misssing; ♀portion of spike after dehiscence of capsules, ×0.5; apical view of gynobase from terminal node of ♀ spike, ×1.5.

Dry open oak forests, rocky summits, 2400–2500 m, collected with flowers May–Aug, with mature fruit Aug–Nov.

Known from a single locality in Michoacán, where abundant: Mpio. Yurécuaro or La Piedad, near summit of Cerro Grande de Cujuarato, SW of La Piedad (*Zamudio 9352*, with R. González T. and E. Pérez, with fls and fr, IEB!, the holotype; MICH!, isotype; *Labat 1590*, tips of branches with ♂ spikes, IEB, MEXU; *Cházaro 5158*, tip of branch with fruit, IEB, MEXU; *Rzedowski & McVaugh 513*, fruiting branch with full-sized leaves, ENCB, MICH).

Described as a shrub up to 1 m high, or an herb 1–1.3 m high, with white latex, branching at least near the tips of the stems, the basal parts unknown; leafy stems green or reddish, smooth, subherbaceous, with no trace of lenticels; leaves alternate, or opposite at some distal nodes; stipules membranous, subulate-attenuate, commonly 2–3 (–4.5) mm long and 0.3–0.5 mm wide at base, often bisected or trisected with 2 or 3 unequal segments, the whole up to 1 mm wide at base; petioles 1–4 mm long, stout, thin-edged and 1–2 mm wide; blades dark green adaxially, paler abaxially, ovate (narrowly so on some younger branches), those of cauline leaves 5–13 cm long, 2.5–6 cm wide, 1.6–2.2 times as long as wide (or up to 2.7 times on some leaves near tips of branches), prominently long-acuminate and sometimes falcate at apex, broadly rounded at base and there decurrent on the petiole; margins finely (but conspicuously) and closely antrorsely serrulate with ca (7–) 10–15 teeth per cm, the teeth mostly broad-based and with blunt swollen tip, often incurved, sometimes with a small sessile deciduous glandular body on the distal side of the tooth near the tip; cupuliform marginal laminar or petiolar glands none; inflorescences up to 5–8 cm long, thickened proximally (up to 4 mm thick in fruit), sessile or the peduncle 1–2 cm long; ♀ flowers 1–4 at intervals of 5–12 mm along the axis; ♂ portion of the spike 1.5–4 cm long, the cymules crowded or up to 1–2 mm apart, spirally arranged, 1-flowered; glands of the bracts fleshy, rotund or somewhat elongated, often 1–1.5 mm in diameter, flat or patelliform; bracts pinkish or whitish, somewhat enfolding the flower and pedicel, ovate, 1.5–2 mm long and wide, apiculate, with erose margins; flowers on thick articulate pedicels 0.5–1 mm long; calyx short-stipitate, above the stipe funnelform, strongly compressed, 2 mm long, somewhat 2-lobed, open but the lobes infolded, the whole ca 2.8 mm wide at the margin, with 1 stamen curved out and exserted from each corner of the calyx; filaments ca 3 mm long, the anthers 1 mm long, wider than long, the two locules divergent from the apex downward; ♀ flowers apparently naked, the ovary broadly ovoid, tapering to an acute apex, the styles 4.5–5 mm long, filiform, very slightly united at base, straight or gradually recurved; fruits solitary, sessile, subtended by flat rounded glands ca 1.5–1.8 mm in diameter; capsule not seen intact, rotund, 3-lobed, somewhat pointed at apex, ca 1 cm in diameter; columella 5.5–8.5 mm long (measured from the base of the gynobase), sharply 3-angled, ca 1–1.5 mm thick at the midpoint, thence abruptly expanded toward both ends, 4–5 mm wide at the apex, where 3 flat winglike angles alternate with 3 peglike projections (?remains of the funicles); gynobase thickened distally, becoming convex below the base of the columella, its lobes 3–4.5 mm long, up to 4 high at base, and 2 mm thick, not upcurved-falcate, but laterally spreading with short upcurved points, the points of adjacent lobes 8–8.5 mm apart; seeds ellipsoid-ovoid or commonly subglobose with well-marked adaxial line, oblique at apex, gray or brown, 5.5–6 mm long, ca 5–5.5 mm wide, 4.5 mm thick, smooth or the outer layers seemingly wrinkled as if shrunken in drying; caruncle inconspicuous, whitish, with 2 adaxially oriented nearly parallel lobes 0.5 mm long.

All the known material of this species was originally identified with *Stillingia zelayensis*, which it much resembles in habit and size and in its subherbaceous growth and probably annual aerial stems. The leaf-blades, however, are sufficiently broadly ovate and short-petiolate to look out of place in *S. zelayensis*, the marginal teeth of the blades are differently shaped, often with thicker tips and wider bases, and as far as I have observed there are no cupuliform glands at the leaf-bases, as there often are in *S. zelayensis*. There are subjective but clearly real differences between the gynobases of the two taxa, and the caruncle of the seed is much smaller and flatter in *S. pietatis*. In spite of these and other small differences between the two entities, they seem almost too close to be called distinct species, except for the difference in the number of ♂ flowers in a cymule, which according to the system advocated by Rogers (1951) puts them in different subgenera of *Stillingia*! The Mexican species of the group with a single stamen are referred to subgenus *Gymnostillingia*, series *Treculianae*. If one includes *S. pietatis*, there are three rather dissimilar species in series *Treculianae*, one in southern California, one in Texas and the northeastern border states of Mexico, and one in western Michoacán.

Cerro Grande, the type-locality of *Stillingia pietatis*, is an isolated volcanic cone rising conspicuously above the valley of the Río Lerma. It supports a dry oak forest with a seemingly limited flora, but among the abundant plants is a white-flowered species of *Ceanothus* (*C. buxifolius* Humb. & Bonpl. ex J. A. Schult.), which in Nueva Galicia is rare except in similarly isolated dry mountains. Another apparently endemic species, the composite *Verbesina pietatis* McVaugh, was described from the same mountain (Contr. Univ. Michigan Herb. 15: 191. *fig. 1.* 1982).

**Stillingia querceticola** McVaugh, sp. nov., Ser. *Oppositifoliarum*, frutex ramosus ad 1.5–2 m altus, foliis ramisque superioribus oppositis vel subopppositis; foliis (in eodem ramo infimis exceptis) lanceolatis apice anguste prolongatis subacuminatisque, 3–4.5 (–7.5) cm longis, 0.8–1.4 (–1.8) cm latis, plerumque 3–4 (–5)-plo longioribus quam latioribus, petiolis gracilibus (3–) 6–9 mm longis; margines minute serrulatae, dentibus pro cm 12–16, valde ascendentibus vel appressis, apicibus subulatis saepe glandiferis 0.2–0.5 mm longis; dentes marginales interdum in glandulas patelliformes 0.1–0.5 mm latae transientes; glandulae duae patelliformes 0.5–1.3 mm longae, 0.5–0.8 mm latae prominentes laminae basi; spica terminalis crassipedunculata ad 5 cm longa, floribus basalibus ♀ 2–5, parte ♂ multiflora plusminusve interrupta, bracteis ca 15–25, ca 10-floris; bractearum glandulae cyathiformes, 0.5–1.5 mm latae, ad 1–1.5 mm profundae; flores ♂ 1.5 mm longi campanulati sepalis 3; stamina 2, filamentis 1.5 mm longis divergentibus; sepala ♀ subor-bicularia 1 mm longa; styli basi in columnam 1.2 mm longam, 0.7 mm diametro connati, supra columnam valde recurvati 3–4 mm longi; capsula ut videtur ca 10 mm diametro, 8 mm alta; gynobasis lobi 3–3.8 mm longi; semina grisea vel griseo-nigricantia, 4–4.5 mm longa (caruncula carnosa inclusa).

Hillsides in oak forest, in region of deciduous forest, ca 800 m, collected in flower 6 Aug, in fruit 12 Sep.

Known only from north-central Nayarit in the basin of Río San Pedro (Mpio. Acaponeta, road to San Blasito, 2–3 km from the Mesa de Pedro y Pablo, old fruit, *Téllez 12080*, MICH, the holotype; DAV, MEXU, isotypes; *vereda* to San Blasito, 1–2 km SE of Mesa de Pedro y Pablo, fl, *Téllez 10689*, MEXU).

Woody shrub 1.5–2 m high, with latex, well-branched, the upper branches and leaves opposite; branches of the second year 4 mm thick or more, with thin gray-brown roughish and sparingly lenticellate bark; branchlets copiously leafy, the internodes 1–2.5 cm long; stipules ca 0.6 mm long, triangular, the tips soon darkening and deciduous, the persistent bases yellow-brown, 0.5 mm wide; petioles (3–) 6–9 mm long, 0.4–0.7 mm thick, deeply sulcate adaxially, abaxially seeming to be prolonged under the blade and prominent its whole length, diminishing very gradually to the apex; foliar glands conspicuous, patelliform, 0.5–1.3 mm long and 0.5–0.8 mm wide, usually one on each margin, sitting astride at or just below the junction of the petiole with the base of the blade; blades chartaceous or coriaceous, all except those at the lower nodes of branches lanceolate with narrowly prolonged and subacuminate tips, acute or slightly rounded at base and there decurrent on the adaxial margins of the petiole, almost all opposite or suboppposite on branches of the first year, 3–4.5 (–7.5) cm long, 0.8–1.4 (–1.8) cm wide, 3–4 (–5) times as long as wide; lowest leaves on branches elliptic to obovate, obtuse to rounded or emarginate at apex, acute to cuneate at base, 1–3 cm long, 0.5–1.5 cm wide; blades apparently green on both surfaces, not much paler abaxially; small veins evident on both surfaces, on the adaxial surface subimpressed, concolorous, the primary lateral veins inconspicuous in dried leaves; margins slightly revolute, finely antrorsely serrulate with 12–16 teeth per cm, the teeth strongly ascending to appressed, 0.5 mm high or less, with subulate and often gland-tipped points 0.2–0.5 mm long, 1 (or few) of the teeth on each edge sometimes transformed into patelliform glands 0.1–0.5 mm wide; inflorescences terminal, on swollen peduncles 10–17 mm long, the distal portion ♂, yellow, 2–3 cm long, somewhat interrupted toward base, the proximal portion bearing 2–5 ♀ flowers along an axis up to 3–5 cm long, the axis between and below the flowers up to 5 mm wide, 1.5 mm thick (branchlets below the swollen portion 1.2–1.6 mm thick); ♂ bracts ca 15–25, scarious, ca 10-flowered; glands lateral, paired, deeply cup-shaped, 0.5–1.5 mm wide, up to 1–1.5 mm deep; ♂ flowers nearly sessile, ca 1.5 mm long, the calyx campanulate, the sepals imbricate in bud with free tips, splitting irregularly into ca 3 members; stamens 2, the filaments ca 1.5 mm long, divergent, the anthers ca 0.6 mm long, the two locules plump, divergent from the apex downward; ♀ flowers sessile, the sepals thin, scarious, suborbicular, ca 1 mm long and wide; ovary subglobose, narrowing into the thick style-column 1.2 mm long, 0.7 mm thick, the free parts of the styles strongly outcurved, 3–4 mm long, rough adaxially; capsule (not seen mature in place) estimated to have been ca 10 mm in diameter and 8 mm high, with woody endocarp, septicidal and tardily loculicidal, the fallen carpels with a flat broad scar at base showing the broken margins of the exocarp, the scar ca 6 mm wide; outer surface slightly roughened when dry; gynobase sessile, 3-horned, 5–7 mm wide between the tips of adjacent lobes, 2.5–3 mm high, the lobes 3–3.8 mm long, ca 1–1.5 mm thick near base, gradually upcurved to a somewhat more abruptly upturned hard conical tip ca 1 mm long; margins between the horns nearly horizontal with a short central obtuse lobe; columella (not seen complete) thin-winged at base, ca 5 mm long, 3-angled, the terminal portion apparently abruptly expanded and ca 4 mm wide; seeds smooth, dark steel gray to almost black with dull surface, short-ellipsoid, somewhat compressed, 4–4.5 mm long including the caruncle, 3.5–4 mm wide, 3 mm thick, abaxially rounded, weakly rounded adaxially with a strong central line, oblique and flattened toward the apex above the hilum, the caruncle whitish or yellowish, fungoid, depressed-pyramidal, up to ca 1 mm high and 2 mm wide.

This plant was originally identified as *Stillingia zelayensis*, but its affinities are surely with the opposite-leaved shrubs in the genus, including in our flora only *S. sanguinolenta*.

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# THE CAREX LURIDA GROUP (CYPERACEAE) IN THE NEOTROPICS

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The *Carex lurida* Wahlenb. group (sect. *Vesicariae* J. Carey, including sect. *Pseudo-cypereae* Kük.) is restricted to the New World and comprises six known species. Five occur in the neotropics, and one, *C. baileyi* Britton, is restricted to the Appalachian region from New England and New York south to Tennessee and North Carolina. *Carex lurida* is widespread in eastern North America, and scattered in distribution in the neotropics, and the other four species are local endemics.

The *Carex lurida* group is characterized by conspicuously awned pistillate and staminate scales, perigynia with few (4–12) and often faint nerves, and inflated, more or less globular to broadly flattened-ellipsoid bodies. Other similar species in the section have either the staminate or pistillate scales or both awnless, perigynia with many (15–25 or more) and often conspicuous nerves, and often uninflated bodies. In the *C. lurida* group, the beaks are relatively prominent (1.3–5.9 mm long), often equalling or exceeding the length of the body, but with inconspicuous apical teeth only 0.1–0.8 mm long. Other similar species of sect. *Vesicariae* have either shorter beaks or beaks with proportionately longer teeth or both. Also characteristic of the group are papillose achenes (see Walter 1975), although this feature does occur in a few other species in the section.

Eight other members of sect. *Vesicariae* occur in the neotropics and adjacent parts of Mexico. *Carex polysticha* Boeckl. sensu lato, a highly variable species much in need of systematic work, ranges from the Caribbean and southern Mexico to temperate South America. The very similar North American *C. comosa* Boott, unique in having long (1.3–2.8 mm), outcurved beak teeth, also occurs in central Mexico. These two species differ from the *Carex lurida* group in their uninflated, many-nerved perigynia. *Carex acutata* Boott, from the northern Andes, and *C. purpureovaginata* Boeckl. from eastern Brazil have awnless or very short-awned pistillate scales, as well as uninflated perigynia. In central and northern Mexico, *Carex hystericina* Willd., *C. mcvaughii* Reznicek, and *C. thurberi* Dewey occur locally. These three species differ from the *Carex lurida* group in having prominently 15–25-nerved perigynia with proportionately shorter beaks. Finally, *C. utriculata* Boott, with awnless pistillate scales and strongly inflated perigynia, barely enters Mexico from the north in Baja California.

In this treatment, *Carex rzedowskii* and *C. durangensis* are described from Mexico, *C. setigluma* from Ecuador and Colombia, and *C. luridiformis* from Colombia. The presence of *C. lurida* in South America is confirmed, and a key to this group of species is provided.

## Key to the Species of the Carex lurida Group

1. Pistillate spikes (12–) 14–22 mm wide (if spikes less than 14 mm wide, then usually less than 2.5 times as long as wide); perigynia (6–) 6.5–10.8 mm long. *C. lurida.*
1. Pistillate spikes 8–14 (–15) mm wide (if spikes more than 12 mm wide, then usually 2.5–4 times as long as wide); perigynia 3.7–6.7 (–7.6) mm long.
   2. Achenes (0.8–) 1–1.4 mm wide, with obovate to rhombic-ovate sides; leaves 2–4 (–5) mm wide (except in *C. durangensis*).
      3. Leaves 5–9 mm wide; ligule 12–21 mm long; staminate spikes 3–4 mm wide; staminate scales 1.4–2 mm wide. *C. durangensis.*
      3. Leaves 2–4 (–5) mm wide; ligule 2–8 mm long; staminate spikes 1.3–2.7 mm wide; staminate scales 0.7–1.5 mm wide.
         4. Pistillate scales 0.3–0.9 mm wide; perigynium beak 2.2–4 mm long, 0.7–1.3 times as long as the body. *C. baileyi.*
         4. Pistillate scales 1.1–2 mm wide, perigynium beak 1.3–2.3 mm long, 0.5–0.8 times as long as the body. *C. rzedowskii.*
   2. Achenes 0.6–0.9 mm wide, with narrowly elliptic sides; leaves (3.2–) 5–9.5 mm wide.
      5. Pistillate spikes 8–10 mm wide, mostly 4–6 times as long as wide; pistillate scale bodies 1.1–1.7 mm long, 0.4–1.1 mm wide; perigynia 4.2–5.2 mm long; achenes deeply constricted at the middle on one side. *C. setigluma.*
      5. Pistillate spikes 11–13 mm wide, mostly 2.5–4 times as long as wide; pistillate scale bodies 2.5–3.6 mm long, 1–1.8 mm wide; perigynia (4.9–) 5.3–6.7 mm long; achenes slightly constricted at the middle on one side. *C. luridiformis.*

**Carex rzedowskii** Reznicek & S. González, sp. nov.—Type: Mexico. Michoacán: alrededores de Loma Caliente, próxima a Umécuaro, Mpio. Morelia, 27 Nov 1991, *Rzedowski 51352* (holotype: IEB; isotypes: CIIDIR, MICH, and others to be distributed). Fig. 1.

Plantae cespitosae; culmi fertiles 12–45 cm alti, vaginis basalibus purpureis, glabris. Folia 2–6, laminae 5–30 cm longae, 2–3.4 (–4) mm latae, folia superiora culmo longiora; vaginae glabrae, ventraliter albidae vel pallido-brunneae; ligulae 2–3.7 mm longae. Inflorescentiae 2.2–5.5 cm longae; spicae erectae 2–5; bracteae infimae laminis 9–20 cm longis, 1.7–3.2 mm latis; spica terminalis omnino staminata, 0.9–1.6 cm longa, 1.3–2.4 mm lata, pedunculo 1–5 mm longo; spicae laterales 1–4, omnino pistillatae, 1–1.8 cm longae, 8–10 mm latae, floribus 20–50 dense imbricatis. Squamae pistillatae corporibus (1.9–) 2.3–3.7 mm longis, 1.1–2 mm latis, acutis, aristatae, aristis 0.6–2.8 mm longis. Perigynia 3.7–4.9 (–5.4) mm longa, 1.5–2.2 mm lata, inflata, glabra, corporibus biconvexis vel suborbiculatis, in rostrum 1.3–2.3 mm longum contracta. Achenia ca 1.9–2.2 mm longa, (1–) 1.1–1.2 mm lata, trigona. Styli persistentes; stigmata 3. Antherae 3, ca 1.3–2 mm longae.

Cespitose from short-creeping rhizomes up to 4 mm wide; fertile culms 12–45 cm tall, erect, exceeded by the leaves, trigonous with somewhat concave sides, prominently angled, smooth, 0.8–1.3 mm wide (below the inflorescence); bladeless basal sheaths purple, fibrillous with age. Leaves 2–6, mostly on the lower 2/3 of the culm; blades 5–30 cm long, 2–3.4 (–4) mm wide, flat, the margins and midrib antrorsely scabrous distally; leaf sheaths glabrous, very slightly septate-nodulose dorsally, whitish or pale brown, somewhat hyaline at the upper part ventrally, sometimes purple-spotted along the inner band, thin and easily ruptured at the apex; ligules 2–3.7 mm long, rounded to acute, the free portion whitish, 0.2–0.4 mm wide. Inflorescences 2.2–5.5 cm long, up to 2.2 cm wide, with 2–5 spikes, the terminal staminate (rarely absent), the lateral 1–4 pistillate; pistillate spikes approximate or the lower separate, erect, nearly sessile or the lowermost on a peduncle up to 2 cm long; lowermost 1–3 bracts foliaceous, 9–20 cm long, 1.7–3.2 mm wide, antrorsely scabrous along the margin and distally also

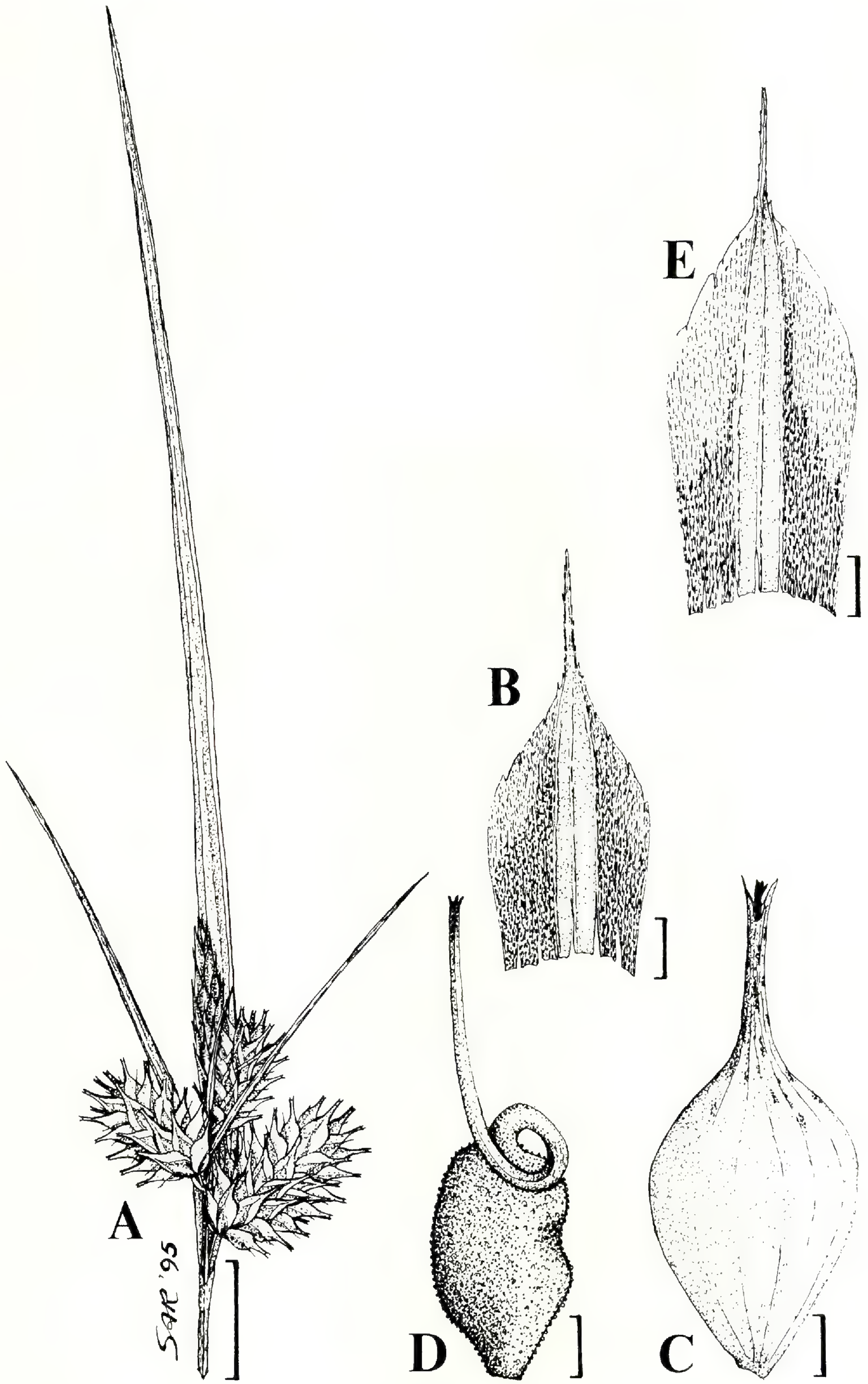


FIG. 1. *Carex rzedowskii.* A. Inflorescence. B. Pistillate scale. C. Perigynium. D. Achene. E. Staminate scale. (Scale: A, bar = 1 cm; B–E, bar = 0.5 mm.) Drawn by Susan A. Reznicek from *Rzedowski 46978* (IEB).

along the midvein, sheathless or with a very short sheath up to 12 mm long, the upper bracts setaceous, reduced. Staminate spike 0.9–1.6 cm long, 1.3–2.4 mm wide, slender, nearly linear, on a very short, smooth peduncle 1–5 mm long. Pistillate spikes 1–1.8 cm long, 8–10 mm wide, short-cylindric, densely flowered with about 20–50 ascending-spreading to spreading perigynia in several to many rows. Staminate scales up to 4.2–7.2 mm long, the body 2.8–5.2 mm long, 0.9–1.5 mm wide, lanceolate to oblanceolate, stramineous to purple with a paler, 3-nerved center, the midrib prolonged into a rough awn 0.4–2.4 mm long, the awn 0.1–0.6 times as long as the body. Pistillate scales 3.2–6.4 mm long, the body (1.9–) 2.3–3.7 mm long, 1.1–2 mm wide, ovate to oblong, pale brown or purple-red-tinged with a 3-nerved center and hyaline margins, acute, the midrib prolonged into a rough awn 0.6–2.8 mm long, the awn 0.4–1.3 times as long as the body, the body of scales covering at least 2/3 of the length of the body of perigynia. Perigynia 3.7–4.9 (–5.4) mm long, 1.5–2.2 mm wide, inflated, biconvex to suborbicular in cross section, cellular-membranaceous, glabrous, stramineous and purple-dotted or pale brown, somewhat shiny, very faintly 4–12-nerved, sessile or short-pedicellate, contracted into a beak; beaks 1.3–2.3 mm long, ca 0.5–0.8 times as long as the body, smooth, cylindrical, slender, stramineous, pale brown or pale green, bidentate at the apex with slender, stiff, erect teeth up to 0.7 mm long. Achenes 1.9–2.2 mm long, (1–) 1.1–1.2 mm wide, trigonous with convex sides above, at maturity slightly or clearly constricted at the middle on one side, obovate, papillose, yellowish brown and somewhat iridescent, stipitate, at the apex tapering and continuous into the persistent, contorted style; stigmas 3. Anthers 3, 1.3–2 mm long.

Known only from two collections from the type locality in Michoacán at 2200 m, in a marshy meadow in the bottom of a valley (Fig. 6). Fruiting is from August to November.

ADDITIONAL SPECIMENS EXAMINED. **Mexico.** MICHOACÁN: Mpio. Morelia, 2 km al S de Umécuaro, *Rzedowski 46978* (IEB, MICH).

The epithet "*rzedowskii*" honors the collector and eminent botanist, Dr. Jerzy Rzedowski. The closest relative of *Carex rzedowskii* seems to be the South American *C. luridiformis*. In *North American Flora* (Mackenzie 1935), *C. rzedowskii* keys to *C. baileyi* because of its narrow pistillate spikes and perigynia abruptly contracted into the beak. Also, both species have cellular-membranaceous perigynia and share similar achene, leaf, and ligule measurements. However, in addition to the features noted in the key, *C. baileyi* has pistillate scales with the bodies mostly truncate at the apex, perigynia 4.8–6.6 (–7.6) mm long, and angles of the achene costullate.

**Carex durangensis** Reznicek & S. González, sp. nov.—TYPE: MEXICO. Durango: 7 mi SW of El Salto, 11 Jul 1970, *Fitzner 262* (holotype: MSC). Fig. 2.

Plantae cespitosae, rhizoma lignosum; culmi fertiles ca 35–50 cm alti; vaginis basales brunneis vel purpureis, glabris. Folia 4–7, laminae 5–25 cm longae, 5–9 mm latae; vaginae glabrae, ventraliter albidae vel pallido-brunneae; ligulae 12–21 mm longae. Inflorescentiae 7–11 cm longae, spicae erectae 3–4; bracteae infimae laminis 13–21 cm longis, 6.6–7 mm latis; spica terminalis omnino staminata, 3.8–4.8 cm longa, 3–4 mm lata, pedunculo 5–8 mm longo; spicae laterales 2–3, omnino pistillatae, 2.9–4.3 cm longae, 9–10.5 mm latae; floribus 170–300 dense imbricatis. Squamae pistillatae corporibus 1.7–2.5 mm longis, 1.2–1.6 mm latis, truncatis vel

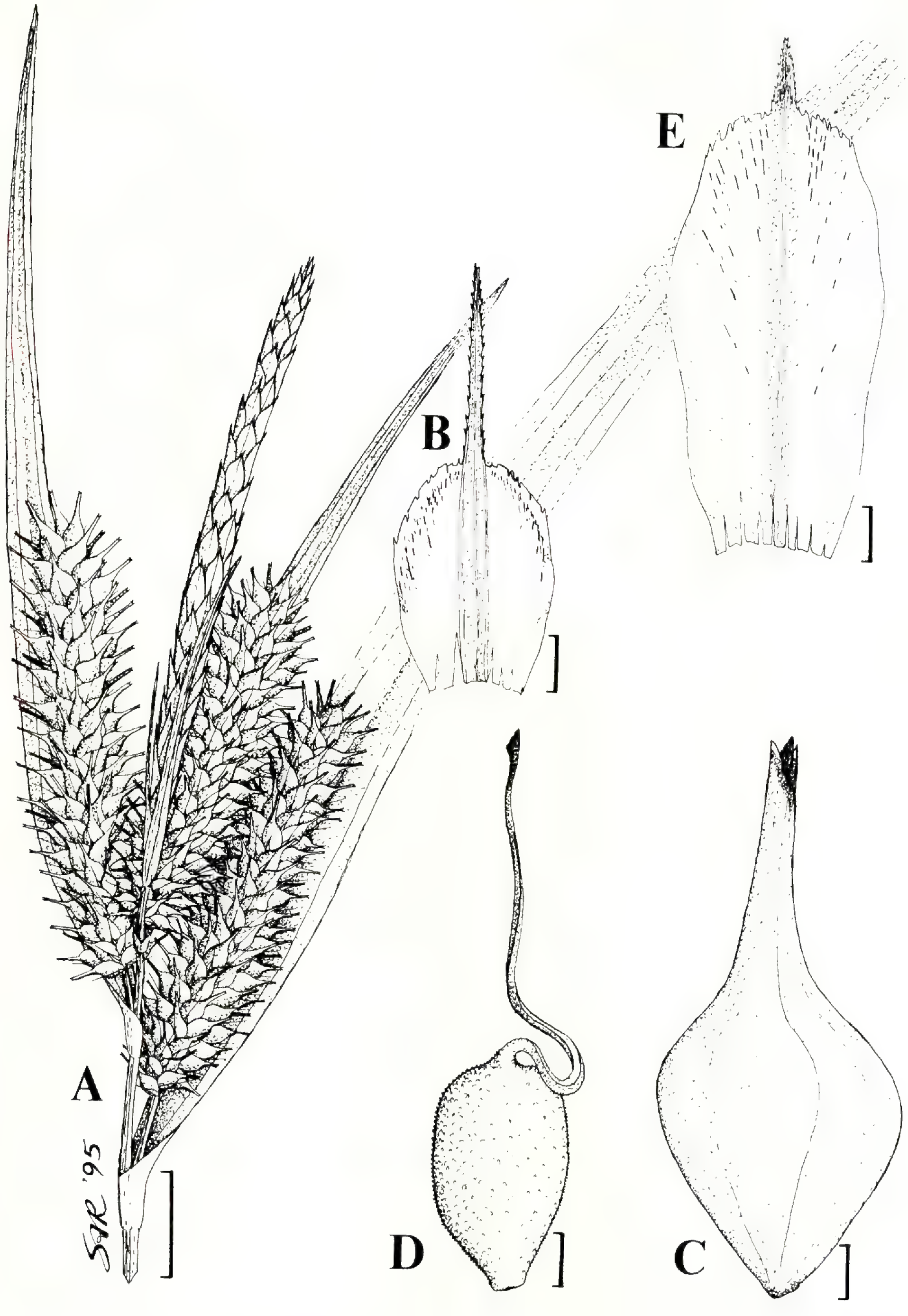


FIG. 2. *Carex durangensis*. A. Inflorescence. B. Pistillate scale. C. Perigynium. D. Achene. E. Staminate scale. (Scale: A, bar = 1 cm; B–E, bar = 0.5 mm.) Drawn by Susan A. Reznicek from *Fitzner 262* (MSC).

acutis, aristatae, aristis 1.1–5.5 mm longis. Perigynia ca 4.5–5.5 mm longa, 1.9–2.2 mm lata, inflata, glabra, corporibus biconvexis vel suborbiculatis in rostrum 1.7–2.3 mm longum contracta. Achenia ca 2.1–2.4 mm longa, 1.1–1.4 mm lata, trigona. Styli persistentes; stigmata 3. Antherae 3, ca 1.6–2.3 mm longae.

Cespitose from stout, woody rhizomes up to 6 mm wide; fertile culms ca 35–50 cm tall, erect, trigonous, prominently angled, smooth or very slightly scabrous, 1.5–1.8 mm wide immediately below the inflorescence; bladeless basal sheaths brown with purple tinging to reddish purple, somewhat fibrillous with age. Leaves 4–7, mostly on the lower 2/3 of the culm; blades 5–25 cm long, 5–9 mm wide, flat, the margins and midrib antrorsely scabrous distally; leaf sheaths glabrous, very slightly septate-nodulose dorsally, whitish or pale brown, somewhat hyaline at the upper part ventrally, thin at the apex; ligules 12–21 mm long, acute, the free portion brownish, 0.2–0.4 mm wide. Inflorescences 7–11 cm long, ca 3 cm wide, with 3–4 spikes, 1 terminal, staminate and 2–3 lateral, pistillate; pistillate spikes approximate or the lower separate, erect, nearly sessile or the lowermost on a peduncle up to 2 cm long; lowermost 1–3 bracts foliaceous, 13–21 cm long, 6.6–7 mm wide, antrorsely scabrous along the margin and midvein, sheathless or with a short sheath up to 15 mm long, the upper bracts reduced. Staminate spike 3.8–4.8 cm long, 3–4 mm wide, linear-cylindric, on a smooth peduncle 5–8 mm long. Pistillate spikes 2.9–4.3 cm long, 9–11 mm wide, cylindric, densely flowered with about 170–300 ascending-spreading perigynia in several to many rows. Staminate scales 4.3–5.8 (–9.4) mm long, the body 4.1–5 mm long, 1.4–2 mm wide, obovate to oblanceolate, brownish to purple with a green, 3-nerved center, acute or the midrib prolonged into a rough awn 0.2–0.8 (–4.6) mm long, the awn 0.05–0.2 times as long as the body. Pistillate scales 2.8–7 mm long, the body 1.7–2.5 mm long, 1.2–1.6 mm wide, ovate to oblong, whitish or purple-red tinged with a green, 3-nerved center, truncate to acute, the midrib prolonged into a rough awn 1.1–5.5 mm long, the awn 0.7–2.5 times as long as the body. Perigynia ca 4.5–5.5 mm long, 1.9–2.2 mm wide, inflated, biconvex to suborbicular in cross section, cellular-membraneous, glabrous, greenish to pale brown, somewhat shiny, very faintly 6–10-nerved, sessile or short-pedicellate, contracted into a beak; beaks 1.7–2.3 mm long, ca 0.5–0.7 times as long as the body, smooth, cylindrical, slender, green to stramineous, obliquely cut at the apex or bidentate with erect teeth 0.1–0.5 mm long. Achenes 2.1–2.4 mm long, 1.1–1.4 mm wide, trigonous with convex sides above, obovate, papillose, whitish to yellowish brown, stipitate, at the apex tapering and continuous into the persistent, contorted style; stigmas 3. Anthers 3, ca 1.6–2.3 mm long.

Known only from the type locality in Durango at 2700 m, on the moist bank of a stream (Fig. 6). Fruiting in July, so far as known.

The short awned to sometimes awnless staminate scales make this species slightly unusual within the *Carex lurida* group. However, it has all the other distinguishing features of the group, including the inflated perigynia with few, faint nerves, relatively prominent perigynium beaks with inconspicuous apical teeth, and papillose achenes. The closest relative of *Carex durangensis* is uncertain. In perigynium and pistillate scale size and shape, it is similar to *C. rzedowskii*. However, in addition to the differences noted in the key, *C. durangensis* is a much larger plant, with thicker culms, longer pistillate and staminate spikes, and short-awned or even awnless staminate scales.

**Carex setigluma** Reznicek & S. González, sp. nov.—TYPE: ECUADOR. Carchi: near El Pun Páramo, 1 Mar 1953, *G. W. Prescott Expedition 701* (holotype: MICH). Fig. 3.

Plantae ut videtur cespitosae; culmi fertiles ca 40–75 cm alti, vaginis basalibus purpureis, glabris. Folia 4–6, laminae ca 10–50 cm longae, (3.2–) 6–9.5 mm latae;

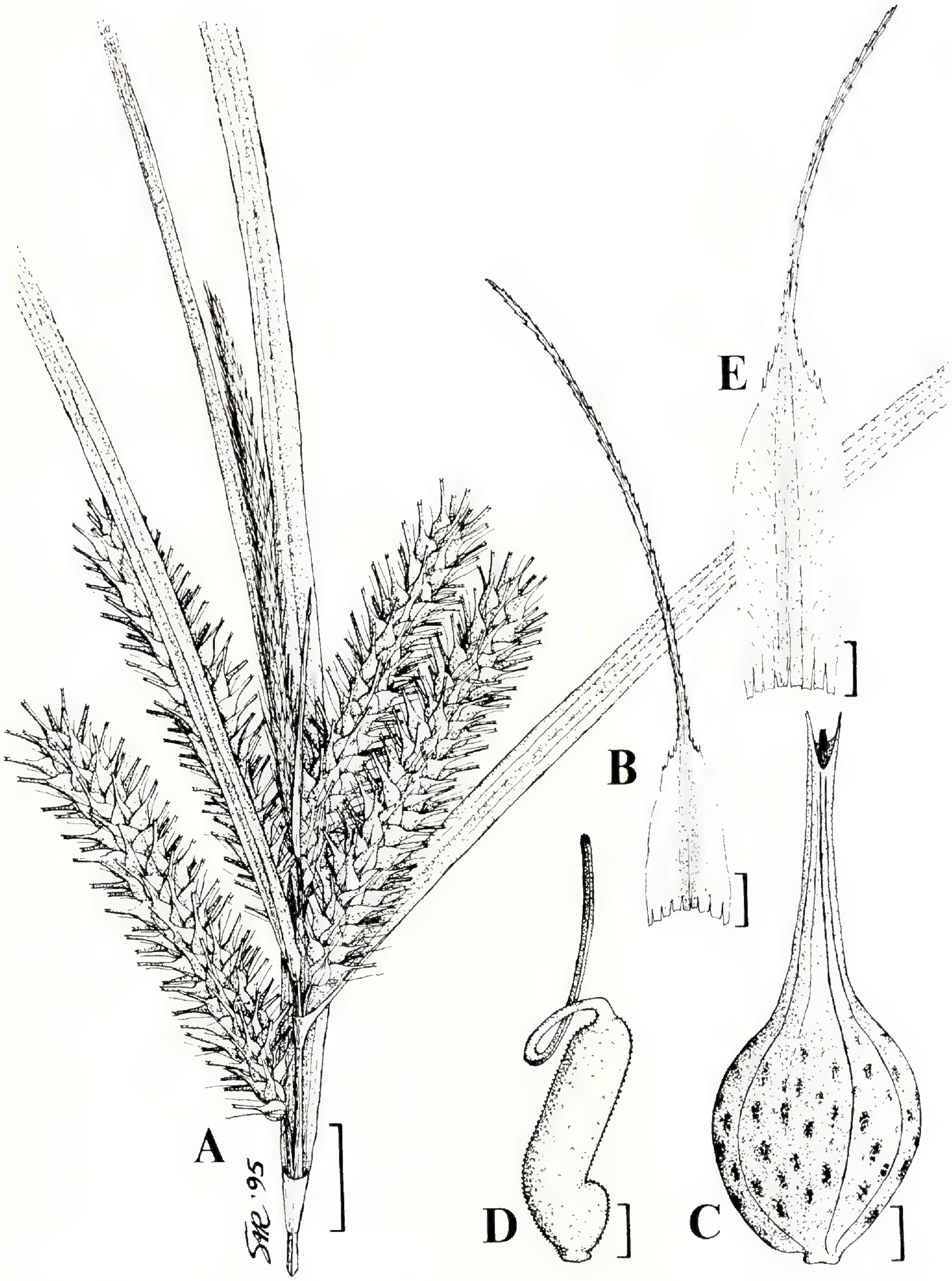


FIG. 3. *Carex setigluma*. A. Inflorescence. B. Pistillate scale. C. Perigynium. D. Achene. E. Staminate scale. (Scale: A, bar = 1 cm; B–E, bar = 0.5 mm.) Drawn by Susan A. Reznicek from *Acosta Solís 7267* (F).

vaginae glabrae, ventraliter albidae vel pallido-brunneae; ligulae 8–18 mm longae. Inflorescentiae ca 7–12 cm longae; spicae erectae 4–5; bracteae infimae laminis ca 11–40 cm longis, 4.6–8.6 mm latis; spica terminalis omnino staminata, 4.5–5.7 cm longa, 2–3.4 mm lata, sessilis aut in pedunculo 1–4 mm longo portata; spicae

laterales 3–4, omnino pistillatae, 3.5–5 cm longae, 8–10 mm latae, floribus 110–180 dense imbricatis. Squamae pistillatae corporibus 1.1–1.7 mm longis, 0.4–1.1 mm latis, acutis, aristatae, aristis 2.2–5.4 mm longis. Perigynia 4.2–5.2 mm longa, (1.4–) 1.8–2.2 mm lata, inflata, glabra, corporibus biconvexis vel suborbiculatis vel subtrigonis, in rostrum 1.8–2.6 mm longum contracta. Achenia ca 1.8–2.2 mm longa, 0.6–0.8 mm lata, trigona. Styli persistentes; stigmata 3. Antherae 3, ca 1.4–2.2 mm longae.

Apparently cespitose from short, woody, fibrillose rhizomes up to 5 mm wide; fertile culms ca 40–75 cm tall, erect, longer than the leaves or exceeded by 1–2 culm leaves, trigonous, smooth or slightly scabrous on the angles, 1.2–2.1 mm wide (below the inflorescence); bladeless basal sheaths purple. Leaves 4–6, mostly on the lower 2/3 of the culms; blades ca 10–50 cm long, (3.2–) 6–9.5 mm wide, flat, the margins, midrib, and adaxial surface antrorsely scabrous distally; leaf sheaths glabrous, septate-nodulose dorsally, whitish or pale brown, ± hyaline at the upper part ventrally, thin and easily ruptured at the apex; ligules 8–18 mm long, ± acute, the free portion whitish, 0.2–1 mm wide. Inflorescences ca 7–12 cm long, 3–5 cm wide, with 4–5 spikes, the terminal staminate, the lateral 3–4 pistillate; pistillate spikes approximate or the lower separate, erect, nearly sessile; lowermost 1–3 bracts foliaceous, ca 11–40 cm long and ca 4.6–8.6 mm wide, antrorsely scabrous distally along the margins, midvein, and adaxial surface, very short sheathing, the upper bracts setaceous, reduced. Staminate spike 4.5–5.7 cm long, 2–3.4 mm wide, slender, linear, sessile or on a very short, smooth peduncle 1–4 mm long. Pistillate spikes 3.5–5 cm long, 8–10 mm wide, long-cylindric, densely flowered with about 110–180 ascending-spreading perigynia in several ranks. Staminate scales 3.1–8.4 (–16.7) mm long, the body 1.9–4.4 long, 0.9–1.4 mm wide, lanceolate to fusiform, pale brown or reddish, the midrib prolonged into a rough awn 1.1–4.9 (–13.4) mm long, the awn ca 0.8–1.7 (–3.1) times as long as the body. Pistillate scales 3.5–6.4 mm long, the body 1.1–1.7 mm long, 0.4–1.1 mm wide, ovate to oblong, whitish hyaline to pale brown or purple-tinged, with a 1–3-nerved center and hyaline margins, acute or rarely bidentate, the midrib prolonged into a rough awn 2.2–5.4 mm long, the awn ca 1.5–3.9 times as long as the body. Perigynia 4.2–5.2 mm long, (1.4–) 1.8–2.2 mm wide, inflated, biconvex to trigonous or suborbicular in cross section, membranaceous, glabrous, pale green and purple-tinged to purplish black, somewhat shiny, faintly nerved or 4–7-nerved at the apex of the body, some of the nerves prolonged into the beak, sessile or very short-pedicellate, contracted into a beak; beaks 1.8–2.6 mm long, ca 0.6–1.1 times as long as the body of the perigynium, smooth, ± cylindrical, slender, pale green to stramineous, obliquely cut at the apex or sometimes bidentate with stiff, erect teeth 0.2–0.6 mm long. Achenes 1.8–2.2 mm long, 0.6–0.8 mm wide, obtusely trigonous with convex sides above, at maturity conspicuously constricted at the middle on one side, oblong, papillose, yellowish brown and somewhat iridescent, sessile or subsessile, at the apex continuous into the persistent, contorted style; stigmas 3. Anthers 3, ca 1.4–2.2 mm long.

Known from two collections from Ecuador and one from an adjacent area of Colombia (Fig. 6). The collections are from wet meadows at 2850 to 3500 m. Fruiting is from January to March.

Additional Specimens Examined. **Colombia.** Nariño: road to Laguna La Cocha, ca 10 km E of Pasto, *Gentry et al. 30414* (F, MO). **Ecuador.** Chimborazo: camino de Pusucucho al Placer, Cord. Oriental, *Acosta Solís 7267* (F).

The epithet "*setigluma*" refers to the long awns of the pistillate and staminate scales (in comparison to the narrow, short body), which give the spikes of this species a "bristly" look.

*Carex setigluma* is closely related to *C. luridiformis*; however, it differs in having longer and narrower spikes, narrower pistillate and staminate scales with shorter bodies and proportionately much longer awns, smaller perigynia with proportionately longer beaks, achenes which are deeply constricted, and septate-nodulose leaves which are scabrous distally. In both species, the degree of development of the purple-black color of the perigynia may vary considerably.

*Carex setigluma* is also quite similar to *C. baileyi* from the northeastern United States in having narrow pistillate spikes, narrow pistillate scales, and the beak of the perigynium being relatively long in relation to the body. In addition to the features noted in the key, *C. baileyi* differs in having achenes that are not constricted at the middle and with costullate angles, pistillate scale bodies mostly with truncate apices, and perigynia uniformly stramineous to olive-green and lacking any purple color.

**Carex luridiformis** Mackenzie ex Reznicek & S. González, sp. nov.—TYPE: COLOMBIA. Cundinamarca: Río San Francisco, above Bogotá, 13 Sep 1917, *Pennell 1931* (holotype: NY, isotypes: F, GH). Fig. 4.

Rhizoma lignosum stolones emittens; culmi fertiles 20–50 cm alti, vaginis basalibus atropurpureis, glabris. Folia 3–8, laminae 9–32 cm longae, (4–) 5–9 mm latae, folia superiora culmo longiora; vaginae glabrae, ventraliter albidae vel rufae; ligulae 2–11 mm longae. Inflorescentiae 3.4–8.5 cm longae, spicae 4–5; bracteae infimae laminis 5–21 cm longis, 3.5–7 mm latis; spica terminalis omnino staminata, 1.5–3.5 cm longa, 3.5–6 mm lata, pedunculo 0.5–8.5 mm longo; spicae laterales 3–4, omnino pistillatae, 1.6–4.2 cm longae, 11–13 mm latae, floribus 35–210. Squamae pistillatae corporibus 2.5–3.6 mm longis, 1–1.8 mm latis, acutis vel truncatis, aristatae, aristis 0.3–3.1 (–4.1) mm longis. Perigynia (4.9–) 5.3–6.7 mm longa, (1.5–) 1.8–2.5 mm lata, inflata, glabra, corporibus biconvexis vel suborbiculatis, in rostrum (1.5–) 1.8–2.2 (–2.4) mm longum contracta. Achenia 2.2–2.6 mm longa, 0.6–0.9 mm lata, trigona. Styli persistentes; stigmata 3. Antherae 3, ca 2–2.1 mm longae.

Loosely cespitose with stout woody rhizomes, rhizomes 0.3–0.5 mm wide; fertile culms 20–50 cm tall, erect or somewhat curved, exceeded by the upper leaves, trigonous, prominently angled, smooth or slightly scabrous-angled above, 1.2–1.8 mm wide (below the inflorescence); bladeless basal sheaths dark purple, fibrillous with age. Leaves 3–8, mostly grouped at the base of the plant and a few along the culms; blades 9–32 cm long, (4–) 5–9 mm wide, flat, canaliculate on the midrib, the margins and midrib antrorsely scabrous distally; leaf sheaths somewhat loosely enveloping the culms, glabrous, very slightly septate-nodulose dorsally, whitish or reddish tinged, thin but scarcely or not hyaline ventrally, often prolonged at the apex, sometimes purple-dotted along the inner band; ligules 2–11 mm long, rounded to acute, the free portion whitish to red-brownish, 0.3–0.8 mm wide. Inflorescences 3.4–8.5 cm long, 3.5–5 cm wide, with 4–5 spikes, the terminal staminate, the lateral 3–4 pistillate; pistillate spikes approximate or the lowermost separate, erect to erect-spreading, sessile or the lowermost on a peduncle up to 2 cm long; lowermost 1–3 bracts foliaceous, 5–21 cm long, 3.5–7 mm wide, antrorsely scabrous along the margins and midvein, sheathless or short sheathing, the upper bracts setaceous, reduced. Staminate spike 1.5–3.5 cm long, 3.5–6 mm wide, on a peduncle 0.5–8.5 mm long. Pistillate spikes 1.6–4.2 cm long, 11–13 mm wide, cylindric, densely flowered with about 35–210 ascending-spreading perigynia in many rows. Staminate scales 4.9–7.6 mm long, the body 4.2–5.4 mm long, 1–2.1 mm wide, oblong-lanceolate, reddish to dark purple with a narrow, paler center, the

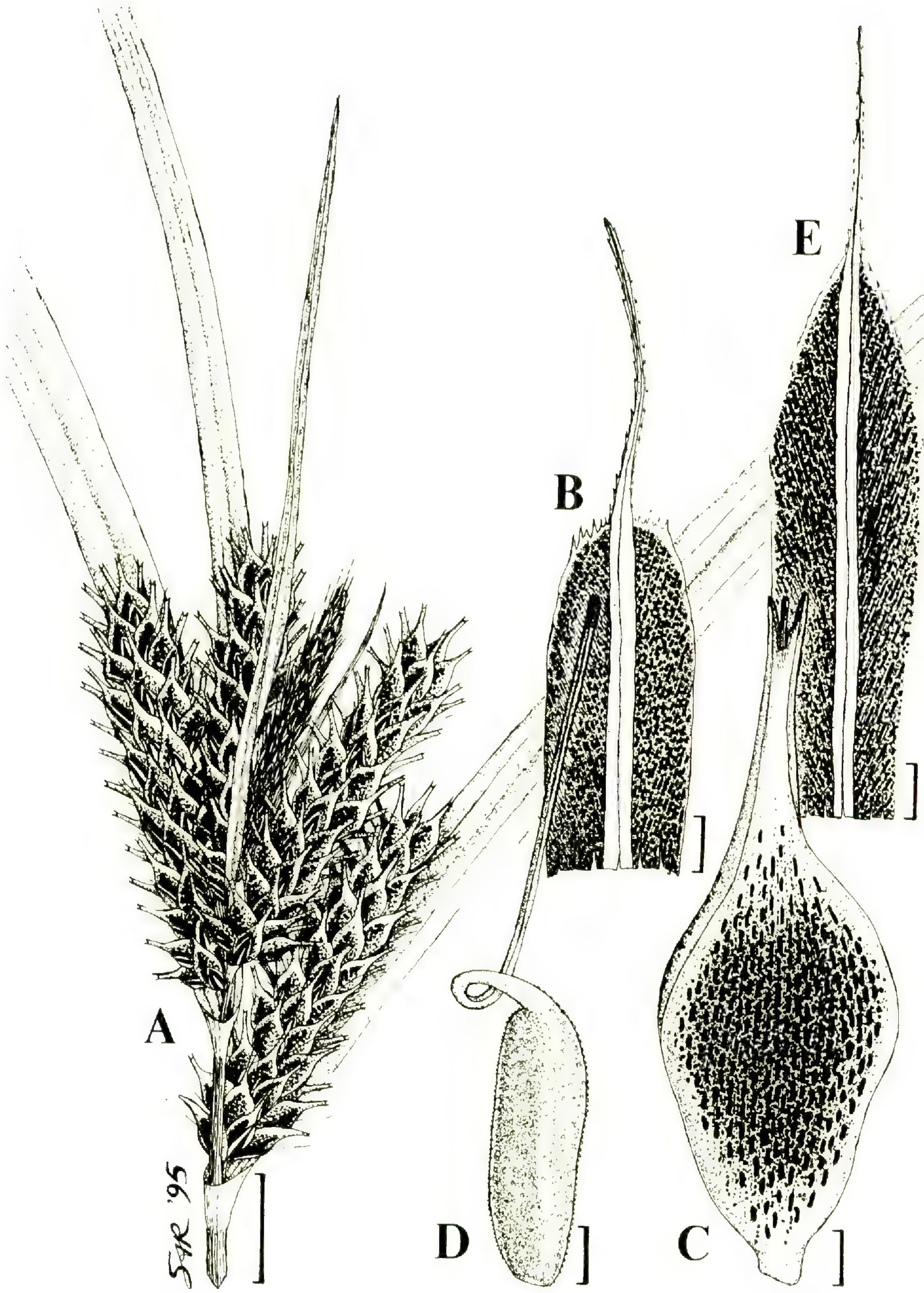


FIG. 4. *Carex luridiformis*. A. Inflorescence. B. Pistillate scale. C. Perigynium. D. Achene. E. Staminate scale. (Scale: A, bar = 1 cm; B–E, bar = 0.5 mm.) Drawn by Susan A. Reznicek from *Pennell 1931* (NY).

midrib prolonged into a rough awn (0–) 0.3–2.7 mm long, the awn mostly 0.1–0.6 times as long as the body. Pistillate scales 4.2–6 mm long, the body 2.5–3.6 mm long, 1–1.8 mm wide, ovate to oblong, dark purple with a green or stramineous center, acute to truncate, the midrib prolonged into a rough awn 0.3–3.1 (–4.1) mm long, the awns mostly 0.3–1.1 times as long as the body, the body of scales

usually covering less than 2/3 of the length of the body of perigynia. Perigynia (4.9–) 5.3–6.7 mm long, (1.5–) 1.8–2.5 mm wide, inflated, biconvex to suborbicular in cross section, membranaceous, glabrous, purple-black or stramineous and densely purple-black dotted, shiny, very faintly few-nerved, short-pedicellate, gradually or abruptly contracted into a beak; beaks (1.5–) 1.8–2.2 (–2.4) mm long, 0.4–0.5 times as long as the body, smooth, cylindrical, green or stramineous, bidentate at the apex with slender, stiff, erect teeth 0.3–0.6 mm long. Achenes 2.2–2.6 mm long, 0.6–0.9 mm wide, trigonous with convex sides above, often slightly constricted at the middle on one side, oblong, papillose, pale brown, sessile or stipitate, at the apex tapering and continuous with the persistent, contorted or abruptly bent style; stigmas 3. Anthers 3, ca 2–2.1 mm long.

*Carex luridiformis* is known from Colombia (Fig. 6), in marshes between 2700 and 3400 m. Fruiting is from July to November.

ADDITIONAL SPECIMENS EXAMINED. **Colombia.** BOYACÁ: Páramo de Guantiva near km marker 230 on road between Belén and Susacón, *Langenheim 3646* (MICH, NY, US).—CUNDINAMARCA: Páramo de Choachi, near Bogotá, moist mossy paramo near Laguna Verjón, *Pennell 2266* (NY); Bogotá, Cruz Verde, *Müller 3831* (MICH); al sur de Usme, entre La Regadera y El Hato, *Idrobo et al. 381* (GH).

*Carex luridiformis* is a striking and distinctive species with wide, often purple-black spikes. Mackenzie died without describing this species, although he recognized it and annotated herbarium material with this name. Subsequently, other specimens of this distinctive species were so named by others based on comparison with the sheets identified by Mackenzie. It seems only fitting finally to publish Mackenzie's name after it has had so much use. The epithet refers to this species having the aspect of *C. lurida*.

Although Kükenthal (1909) placed it under *Carex acutata*, it may be that Boott's (1867) illustration (plate 514) of his mysterious *C. purpurea* (a nomen nudum) was based on a specimen of *C. luridiformis*.

**Carex lurida** Wahlenb., Kongl. Vetensk. Acad. Nya Handl. 24: 153. 1803.—TYPE: America septentrionali, *Hultgren s.n.* (type not traced). Fig. 5.

Cespitose, culms (15–) 25–95 (–110) cm tall, erect, exceeded by the leaves, sharply trigonous with concave sides, the prominent angles often scabrous distally, 0.7–2.1 mm wide immediately below the inflorescence; bladeless basal sheaths reddish purple, usually slightly fibrillous with age; leaves 3–6, mostly on the lower half of the culm, blades 7–50 (–65) cm long, 2.4–11.5 (–13) mm wide, the widest (4–) 4.5–13 mm wide, flat, the margins and midrib antrorsely scabrous distally, also sometimes the adaxial surface just above the ligule; leaf sheaths glabrous, green, slightly septate-nodulose, the inner band whitish hyaline to pale brown, sometimes finely brown-dotted, thin and easily ruptured at the concave apex. Ligules (2–) 2.6–16 (–21) mm long, acute, the free portion whitish hyaline to pale brown 0.2–0.6 mm long. Inflorescences 2.7–18 cm long, up to 8 cm wide, with 2–5 spikes, the terminal staminate, the lateral 1–3 (–4) pistillate, pistillate spikes approximate or the lowermost slightly separate, ascending to spreading, nearly sessile or the lowermost on a peduncle up to 3.1 cm long; lowermost 1–3 bracts foliaceous, the lowermost 9–45 cm long, 2.2–8 mm wide, the margins and midrib antrorsely scabrous distally, sheathless (very rarely with a short sheath up to 1.8 cm long), the uppermost bracts strongly reduced. Staminate spike 1.3–7.8 cm long, 1.6–4 mm wide, peduncle 0.7–1.6 (–3.5) cm long. Pistillate spikes 1.2–6.3 cm long, (12–)

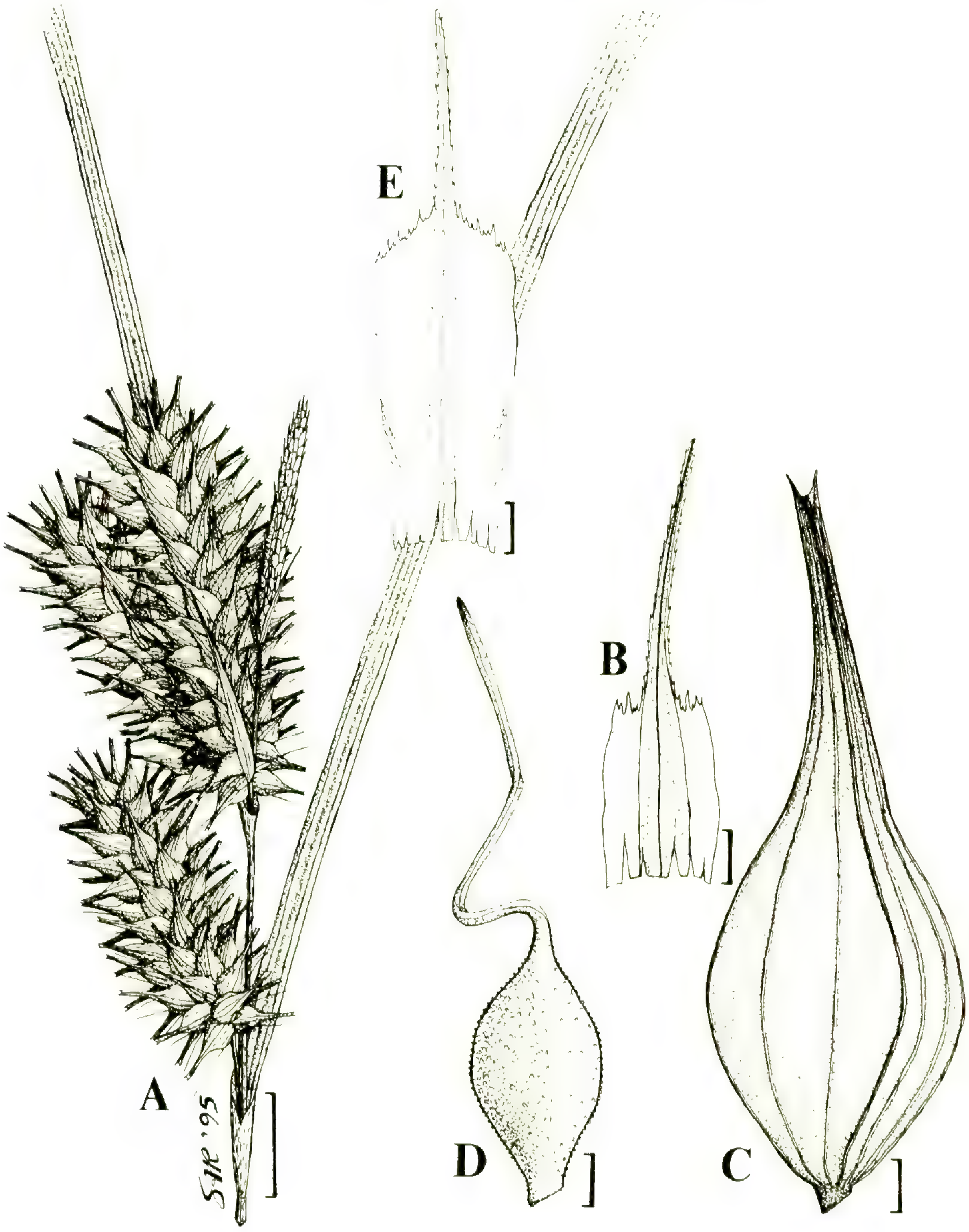


FIG. 5. *Carex lurida*. A. Inflorescence. B. Pistillate scale. C. Perigynium. D. Achene. E. Staminate scale. (Scale: A, bar = 1 cm; B–E, bar = 0.5 mm.) Drawn by Susan A. Reznicek from *Pringle 8160* (MICH).

14–22 mm wide, short cylindric (1–) 1.5–3.5 (–4.5) times as long as wide, densely flowered with ca 18–230 ascending to spreading perigynia in many rows. Staminate scales 4.4–13.4 mm long, the body 2.7–4.8 mm long, 0.9–1.5 mm wide, narrowly lanceolate to narrowly elliptic, whitish hyaline to pale brown, glabrous to scabrous-hispidulous adaxially, truncate to retuse, the midrib prolonged into a rough awn 0.6–10.8 mm long, the awn 0.4–1.9 times as long as the body. Pistillate scales 3.4–11.2 mm long, the body 1.7–5.2 mm long, 0.5–1.1 mm wide, narrowly oblong, whitish hyaline to pale stramineous with a 3-nerved green center, glabrous, usually truncate to retuse, the midrib prolonged into a rough awn 1.6–10.2

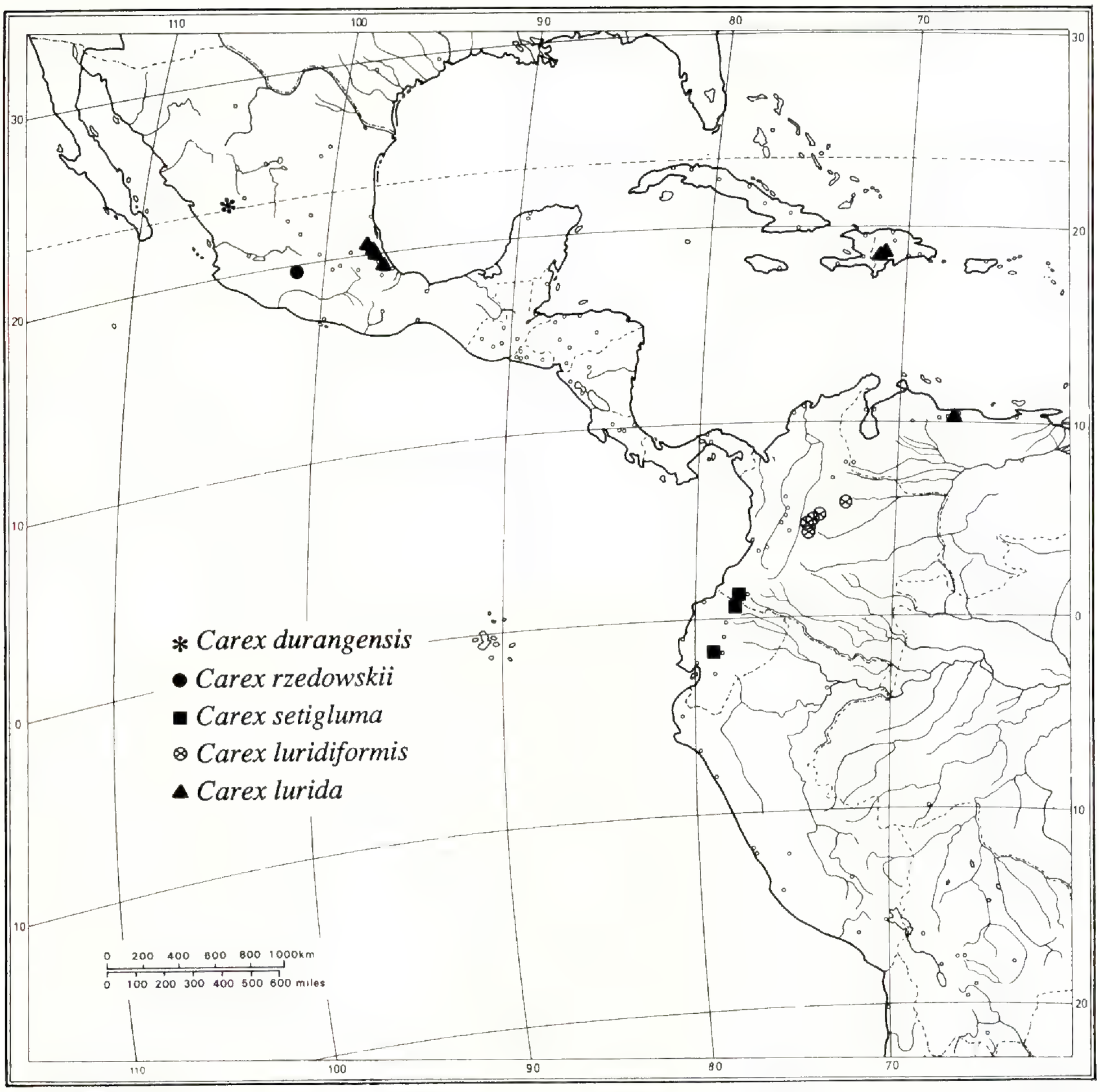


FIG. 6. Distribution of *Carex rzedowskii*, *C. durangensis*, *C. setigluma*, *C. luridiformis*, and *C. lurida* in the neotropics.

mm long, the awn 0.6–3.5 (–6) times as long as the body, the body of the scales mostly less than half the length of the perigynium body. Perigynia (6–) 6.5–10.8 mm long, (1.8–) 2–3.5 (–4.2) mm wide, inflated, more or less suborbicular in cross section, membranaceous, glabrous, stramineous to olivaceous, lustrous, 7–12-nerved, short-stipitate, contracted into a beak; beaks (2.5–) 2.8–5.9 mm long, 0.7–0.9 times as long as the body, smooth, long-tapering and slender, stramineous to olivaceous, bidentate at the apex with slender, stiff, straight teeth 0.2–0.8 mm long. Achenes 1.8–2.8 mm long, 1–1.5 mm wide, trigonous with flat to concave, elliptic to rhombic or somewhat obovate sides, papillose, pale brown, short-stipitate, tapering into the persistent, contorted style; stigmas 3. Anthers 3, 1.7–2.9 mm long.

In the neotropics, known from the Dominican Republic, Mexico, and Venezuela (Fig. 6), between 1300 and 2200 m in swampy areas and on riverbanks. Fruiting is from April to October.

Mackenzie (1935: 462) noted that *C. lurida* was erroneously reported from Central and South America. It had been reported by Kükenthal (1909) based on collections from Venezuela (*Fendler 1579*) and Ecuador (*Jameson 750*). *Fendler*

*1579* is correctly determined as *C. lurida*. We have not seen *Jameson 750*. Knuth (1926) also reported *C. lurida*, based on *Fendler 1579*, from Venezuela. The citation and illustration of *C. lurida* from Colombia (Mora-Osejo 1966) is based on *C. luridiformis*.

The description of *Carex lurida* presented here is drawn from specimens from throughout the range of the species (Nova Scotia to eastern Minnesota, south to Florida and east-central Texas). The few neotropical specimens fall well within the variation exhibited by the temperate plants. Mackenzie (1935) gives the synonymy of this species.

Additional Specimens Examined. **Dominican Republic.** San Juan: Sabana Nueva, Cordillera Central N of Rio Arriba del Norte, *Howard & Howard 9028* (MICH, NY, US); El Valle, headwaters of Bao river, Cordillera Central, *Liogier 12770* (NY); Cordillera Central, Parque Nacional Bermudez, en el Valle de Bao, *Zanoni & García 41731* (NY). **Mexico.** Hidalgo: Distrito Zacualtipán, ca. 3 mi from Zacualtipán on road to Tianguistengo, *Moore 3329* (BH, GH).—Veracruz: carretera al sur de Huayacocotla, 17 km del borde con Hidalgo, *Fay & Calzada 880* (F, IEB); near Jalapa, *Pringle 8160* (F, GH, MEXU, MICH, MO, MSC, NY, PH, SD, US); Rancho Nuevo, Mpio. Chiconquiaco, *Ventura 8167* (IEB, NY); Rancho Nuevo, Mpio. Chiconquiaco, *Ventura 11250* (IEB, VDB). **Venezuela.** [Aragua]: Prope Coloniam Tovar, *Fendler 1579* (GH, PH).

## ACKNOWLEDGMENTS

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# NEW SPECIES OF LEGUMINOSAE FROM NAYARIT, MEXICO

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During 1988–1993, the National Herbarium (MEXU) of the Instituto de Biología UNAM obtained about 15,000 collections as a result of an intensive program of botanical explorations in the state of Nayarit, Mexico, within the framework of the project entitled Flora of Nayarit. The collections included several species new to science. Of these, three new species of Leguminosae (*Tephrosia microcarpa*, *T. sousae*, and *Rhynchosia elisae*) are here described, and their geographical distribution, ecological attributes, and their recognized relationships are discussed.

**Tephrosia microcarpa** O. Téllez-Valdés, sp. nov.—TYPE: MEXICO. Nayarit: Mpio. Tepic, a 10 km al NE de Francisco I. Madero, camino a Pochotitán, 21°33'N, 104°48'W, pastizal inducido en bosque de *Quercus* alterado, 4 Feb 1989 (fl, fr), *Téllez V. & Flores 11780* (holotype: MEXU!; isotypes: ENCB! MEXU! MICH! MO!). Fig. 1.

Planta perennis, fruticosa, decumbens. Folia (3–) 4.5–14 cm longa, (3–5) 7–9-foliolata. Inflorescentiae terminales et axillares 13–29 cm longae. Flores 1.7–1.9 cm longi; calyx 1.0–1.2 cm longus; lobulus vexillaris 7–7.5 mm longus, laterales 7–8 mm longi, carinalis 8–9 mm longus; corolla roseola; stylus barbatus; ovula 1–2. Legumen 1.2–1.4 cm longum, 0.4–0.5 cm latum; semina 1–2, 2–2.5 mm longa, 1.5 mm lata, oblonga.

Perennial and decumbent subshrub. Stems rounded to slightly angulate, densely strigose to glabrescent with age. Leaves (3–) 4.5–14 cm long; leaflets commonly 7–9, (3–5–) 9 at the base of the inflorescences, 2.7–8 cm long, (0.2–) 0.6–1.5 cm wide, linear, linear-lanceolate, lanceolate, oblong-lanceolate to oblanceolate, apex acute to rounded, truncate or emarginate, mucronate, base acute to rounded, adaxially cinereous-strigose to glabrescent, abaxially densely cinereous-strigose, wooly; stipules 5–9 mm long, 2–4 mm wide, broadly oval to subreniform, glabrous but striated adaxially. Inflorescences of terminal and axillary fasciculate pseudoracemes 13–29 cm long; primary bracts 4–6 mm long, 5–9 mm wide; pedicels 5–8 mm long. Flowers 1.7–1.9 cm long; calyx 1.0–1.2 cm long, vexillar lobe 7–7.5 mm long, ovate-lanceolate, subulate, lateral lobes 7–8 mm long, lanceolate-subulate, carinal lobes 8–9 mm long, lanceolate-subulate. Corolla bright pink to deep red with a yellowish green spot at the base of banner; banner ca. 1.3 cm high, 1.3–1.4 cm wide, the claw 5 mm long, suborbicular, dorsally finely cinereous-strigose; wings ca. 1.1 cm long, ca. 0.5 cm wide, the claw 0.4 cm long, oblong, auriculate; keel ca. 1.0 cm long, ca. 0.7 cm deep, the claw 0.3 cm long. Staminal tube 1.1–1.2 cm long, vexillar stamen coherent with the tube at the inferior half, free at the base, with a prominent thickening close to the base. Ovary ca. 5 mm long, cinereous-strigose,

FIG. 1. *Tephrosia microcarpa* (*Téllez V. & Flores 11780*). a. Branch with leaves, flowers, and fruits. b. Bracteole. c. Calyx. d. Banner. e. Wing. f. Keel. g. Staminal tube and barbate style. h. Legume with the staminal tube persistent on the stylar region. i. Opened legume with seeds. j. Seed.

the style barbed over the entire surface; ovules 1–2. Legume 1.2–1.4 cm long, 0.4–0.5 cm wide, subglobose or oblong to elliptic, densely strigose to hirsutulous, appearing wooly; seeds 1–2, 2–2.5 mm long, 1.5 mm wide, 1–1.5 thick, oblong, light brown, smooth.

ADDITIONAL SPECIMENS EXAMINED. **Mexico.** NAYARIT: Mpio. Tepic, a 8.6 km al SW de Pochotitán, pastizal derivado de encinar con *Aeschynomene*, *Byrsonima*, *Calliandra*, *Asclepias*, *Croton*, *Spermacoce*,

Compositae, etc., 19 Jun 1987 (old fr), *Téllez V. & Miller 10434*, *10441*, *10452* (MEXU), 20 Jun 1987 (fl, fr), *10522* (MEXU).

*Tephrosia microcarpa* is easily recognized among the rest of the American species of the genus by its small 1–2-seeded legume. This character is only shared with *T. nubica* (Boiss.) Baker and *T. polyphylla* (Chiov.) Gillet (sect. *Pogonostigma*) (Gillet 1965) from Eastern Africa to Arabia. Accordingly, there is no evidence from Wood's revision (1949) that can suggest a possible relationship of this new species to an American one.

*Tephrosia microcarpa* is phytogeographically interesting. The discovery of this species in Mexico reinforces the idea of a Laurasian origin at least for the Mexican species of *Tephrosia*. The idea is supported by two points. 1) There are several East African and mainly Asiatic species that are morphologically very similar to the Mexican ones. Ninety percent of them belong to subg. *Barbistylia*, as do many other species from those parts of the world. 2) The West African and South American species are closely related and basically belong to subg. *Tephrosia*. These two arguments suggest that *T. microcarpa* is a palaeoendemic species, and that subg. *Barbistylia* originated in the Old World and subsequently migrated from Asia through Europe and North America to western Mexico. This type of pattern has already been suggested by Sousa and Delgado (1993) for other genera of Mexican legumes.

**Tephrosia sousae** O. Téllez-Valdés, sp. nov.—TYPE: MEXICO. Nayarit: Mpio. Ruiz, a 7 km al E de El Venado camino a Real del Zopilote, bosque de *Quercus*, 7 Feb 1985 (fl, fr), *Téllez V. & Magaña 8272* (holotype: MEXU!; isotypes: ENCB! MEXU! MICH! MO!). Fig. 2.

Planta fruticosa, perennis. Folia (5–7–) 9–17-foliolata, 12.7–19.6 cm longa. Inflorescentiae terminales foliis oppositae, 12.5–34 cm longae. Flores 1.3–1.9 cm longi; calyx 5–6 mm longus; lobulus vexillaris 1–1.5 mm longus, laterales 2–2.5 mm longi, carinalis 2.5–3 mm longus; corolla roseola; stylus barbatus; ovula 8–9. Legumen 4.3–5.1 cm longum, 0.5–0.6 cm latum; semina 8, 2–3 mm longa, 1.5–2 mm lata, oblonga.

Sympodial shrub 1–2.5 m tall. Stems, rachis of the leaves, and axes of inflorescences angulate to prominently sulcate. Leaves 12.7–19.6 cm long, sessile to rarely with a short petiole 2–7 mm long; leaflets commonly 9–17 (5–7 at base of inflorescences), (1.1–) 3.2–7.6 cm long, (0.4–) 0.8–2.9 cm wide, lanceolate, oblong-lanceolate, ovate-lanceolate to linear-lanceolate, apex acute, mucronate, base rounded to acute, sometimes revolute, the lower leaflets ovate, cordate to suborbicular, adaxially glabrous to spreading, strigulous on the principal nerve, abaxially densely cinereous-strigose; stipules 6–7 mm long, 0.5–1 mm wide, linear-subulate to linear-lanceolate, striate. Inflorescences of fasciculate pseudoracemes 12.5–34 cm long, terminal and apparently opposite to the leaves; flowers 2–4 per node, pedicels 4–7 mm long. Flowers 1.3–1.9 cm long; calyx 5–6 mm long, campanulate, vexillar lobes 1–1.5 mm long, lateral lobes 2–2.5 mm long, carinal lobes 2.5–3 mm long. Corolla pink; banner 1.3–1.6 cm long, 1.3–1.5 cm wide, the claw 0.4 cm, suborbicular; wings 1.2–1.4 mm long, 0.3–0.45 cm wide, the claw 0.2–0.3 cm long, oblong; keel 1.1–1.2 cm long, 0.6 cm deep, the claw 0.3–0.4 cm long. Staminal tube 1.0–1.2 cm long, the vexillar stamen free. Ovary strigulous, ovules 8–9. Legume 4.3–5.1 cm long, 0.5–0.6 cm wide, straight to slightly recurved at apex, spreading-strigose;

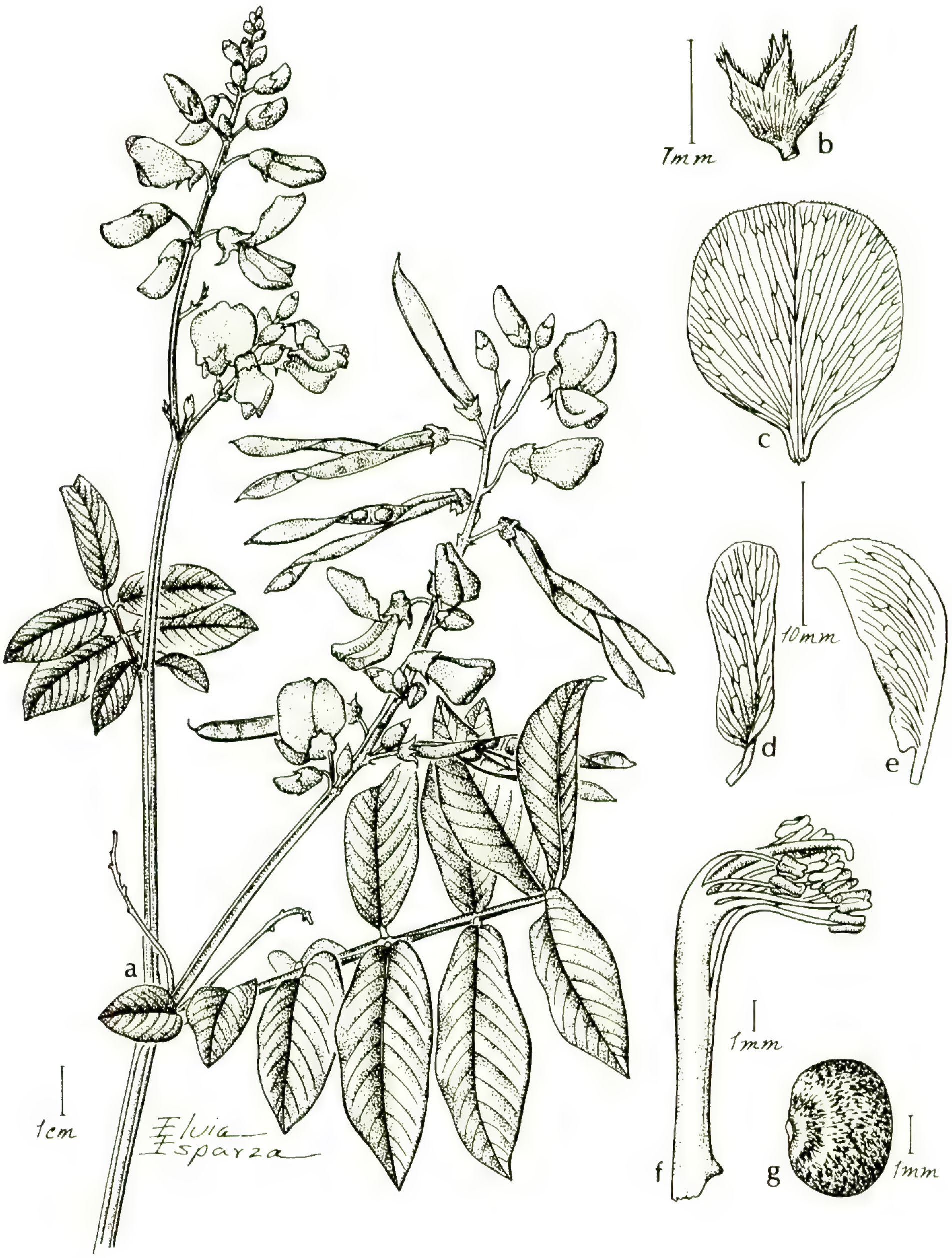


FIG. 2. *Tephrosia sousae* (*Téllez V. & Magaña 8272*). a. Branch with leaves, flowers, and fruits. b. Calyx. c. Standard. d. Wing. e. Keel. f. Staminal tube, showing anthers and barbate style. g. Variegated seed.

seeds 8, 2–3 mm long, 1.5–2 mm wide, 1.5–2 thick, oblong, light-brown, variegated with gray, smooth.

ADDITIONAL SPECIMENS EXAMINED. **Mexico.** NAYARIT: Mpio. Ruiz, a 7 km al E de El Venado camino a Real del Zopilote, bosque de *Quercus*, 7 Feb 1985 (fl, fr), *Téllez V. & Magaña 8294* (MEXU).

*Tephrosia sousae* is very similar to *T. mexicana* Wood in its habit, sympodial growth, and leaflet form and pubescence. It has larger and branched inflorescences, shorter lateral and carinal calyx lobes, and narrower fruits than *T. mexicana*, and very often sessile leaves. Also, *T. sousae* is endemic to the Sierra Madre Occidental in the state of Nayarit, and *T. mexicana* is endemic to the Transvolcanic Belt in the state of México.

The name honors Mario Sousa Sánchez, student of Mexican legumes and teacher of many Mexican botanists.

**Rhynchosia elisae** O. Téllez-Valdés, sp. nov.—TYPE: MEXICO. Nayarit: Mpio. Tepic, Km 5.4 de la terracería a El Cuarenteño, camino que empieza a 500 m al W de El Izote, carretera a Jalcocotán, 21°29'N, 104°59'W, bosque mesófilo, 29 Jan 1990 (fl), *Téllez V. 12583* (holotype: MEXU!; isotypes: ENCB! MEXU! MICH! MO!). Fig. 3.

Herba volubilis, scandens. Folia 3-foliolata, (6–) 8–21 cm longa. Stipulae 9–12 mm longae, 4–7 mm latae, ovato-lanceolatae, acuminatae. Inflorescentiae axillares (2–) 4–14 cm longae. Flores 1.0–1.2 cm longi; calyx 8–11 mm longus; lobulus vexillaris 0.85–1.1 cm longus, laterales 0.8–1.0 cm longi, carinalis 0.9–1.1 cm longus; corolla flava. Legumen 1.5–2.0 cm longum, 0.8–1.1 cm latum; semina immatura 1–2, fusca.

Twining herb. Stems lineate to angulate, hirsutulous to densely hirsute, ferruginous, cinereous, or blackish. Leaves (6–) 8–21 cm long; leaflets 3, lanceolate, lateral asymmetric with the principal nerve not central, 3-nerved from petiole, apex acute to acuminate, mucronate, base subcordate; petiole 2.8–7.7 cm long; stipules 0.9–1.2 cm long, 0.4–0.7 cm wide, ovate-lanceolate, acuminate, red-brown, strigose, glabrous but lineate adaxially. Inflorescences of axillary racemes (2–) 4–14 cm long, shorter than the leaves; pedicels 2–3 mm long; bracts 1.2 cm long, 0.7 cm wide, ovate to deltate or triangular, acute, hirsute with dark brown to black hairs; glabrous but striate adaxially, deciduous. Flowers 1.0–1.2 cm long; calyx 0.8–1.1 cm long, campanulate; vexillar lobe 0.85–1.1 cm long, fused for 3/4 of its length, the apical 3 mm free, lateral lobes 0.8–1.0 cm, carinal lobes 0.9–1.1 cm long, lanceolate, acute to acuminate; banner 1.1–1.2 cm long, 1.1–1.2 cm wide, the claw 0.2–0.3 cm, suborbicular; wings 1.0–1.1 cm long, 0.25–0.35 cm wide, the claw 0.3 cm, oblong; keel 7–8 mm long, 6–7 mm deep, the claw 3 mm. Staminal tube 6–7 mm long (1.0 cm long including filaments); stamens diadelphous, 9 connate, the vexillar stamen free. Ovary densely hirsute, style glabrous, slightly striate or lineate, curved 90°, thickened in 2/3 parts of its length; ovules 1–3. Immature legume 1.5–2.0 cm long, 0.8–1.1 cm wide, dark brown, hirsute-ferruginous; immature seeds 1–2, light brown.

ADDITIONAL SPECIMENS EXAMINED. **Mexico.** NAYARIT: Mpio. Tepic, Km 10–13 de la terracería a El Cuarenteño, camino que empieza a 400 m al W de El Izote, carretera Tepic–Miramar, bosque mesófilo de *Pinus*, *Quercus*, *Carpinus*, *Clethra*, *Cornus*, etc., 4 Jan 1986 (fl) *Téllez V. 9535* (MEXU), 29 Mar 1987 (young fl, fr) *Téllez V. 10026, 10038* (MEXU).

*Rhynchosia elisae* is closely related to *R. tarphantha* Standl. and *R. reticulata* (Sw.) DC. The three species belong to section *Arcyphyllum* Torrey & A. Gray. They share a subfoliaceous to foliaceous calyx; the lobes are free from the base, lanceolate, and equal or exceeding the banner. *Rhynchosia elisae* differs from

FIG. 3. *Rhynchosia elisae* (*Téllez V. 12583*). a. Branch with leaf and young inflorescence. b. Calyx. c. Banner. d. Wing. e. Keel. f. Staminal tube, the vexillary stamen free, with distal portion of style.

*R. tarphantha* and *R. reticulata* in its ovate-lanceolate to elliptic, acute to occasional long-acuminate leaflets, and the stems (mainly the younger ones) as well as the calyx and bracts are densely hirsute-ferruginous. Also, *R. elisae* has intense yellow flowers and the inflorescences shorter than the leaves.

The species is dedicated to my wife Elisa Poo for her help and support.

## ACKNOWLEDGMENTS

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# THE CHROMOSOMES OF SADLERIA (BLECHNACEAE)

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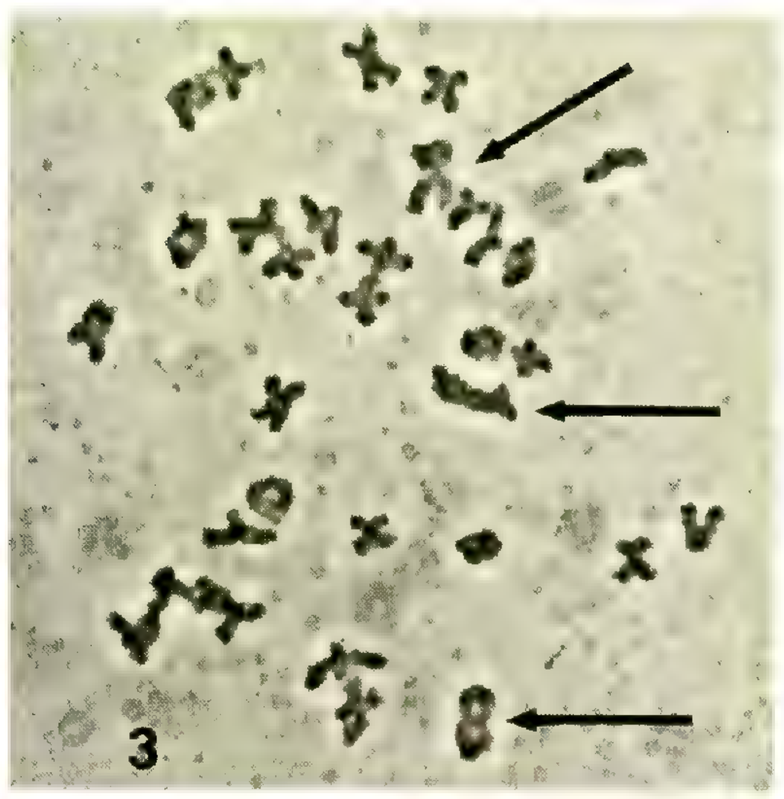
An accurate chromosome count for *Sadleria*, a genus of ferns endemic to the Hawaiian Islands (Fig. 1), has been remarkably difficult to obtain. Efforts to determine the number of pairs at meiosis have been made sporadically since 1965, and the frustration has been exacerbated by the fact that the number of pairs (32–35) is obviously not unusually high in terms of pteridophyte chromosomes. The number of spore mother cells available in any preparation, however, is low, since only 16 spores are produced in each sporangium (Fig. 2) instead of the more usual 64. The chromosome figures have shown complete pairing, and therefore the difficulties in interpretation did not lie with distinguishing pairs and univalents. The problem involves separating which are the actual pairs. Figure 3 illustrates a typical chromosome squash for *Sadleria,* with arrows indicating the areas difficult to interpret.

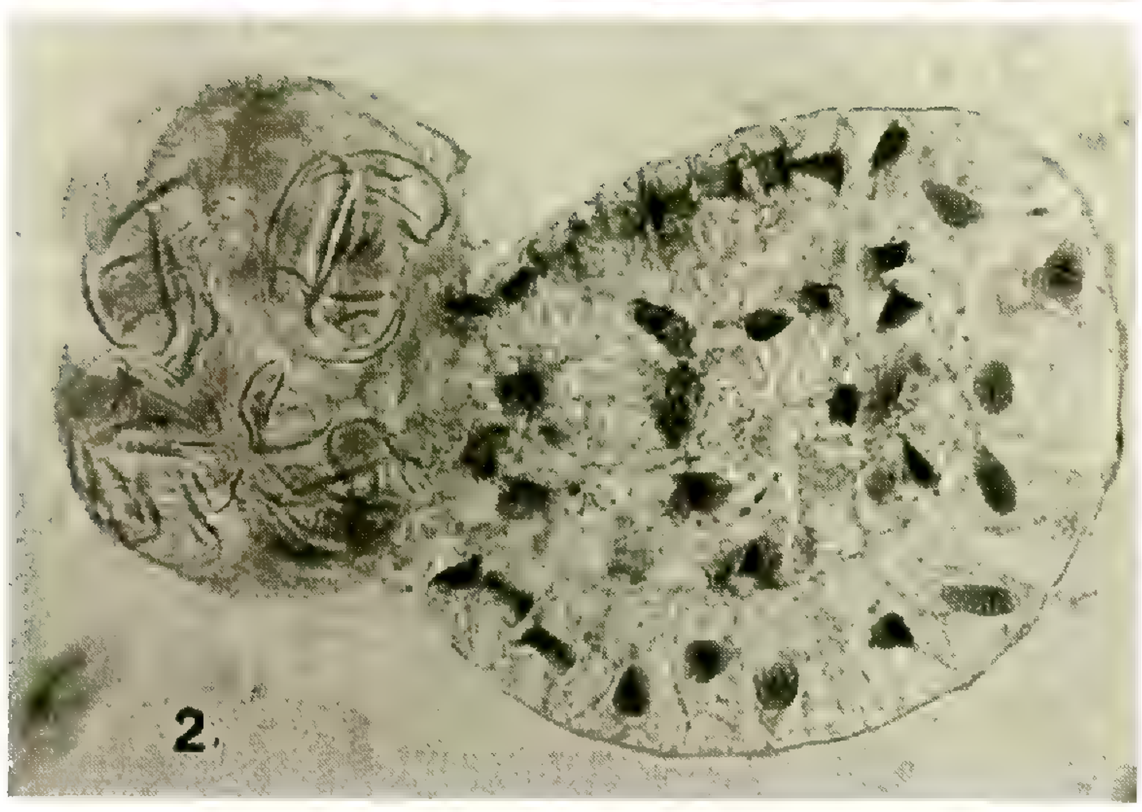
Recently a chromosome figure for *Sadleria squarrosa* (Gaud.) T. Moore, from East Maui, was obtained in which the chromosomes appeared to be more condensed than usual, and the pairs well separated. These showed an unmistakable count of 33 pairs (Fig. 4). The figure illustrated here also reveals the source of the problem—the fact that the meiotic pairs of *Sadleria* chromosomes are not uniform in length. One or two pairs are approximately twice the size of the smaller ones. Most of the chromosome pairs, when drawn at the same level, are of the same size and small, but the larger ones clearly account for problems in determining an accurate count in those figures with less condensed chromosomes.

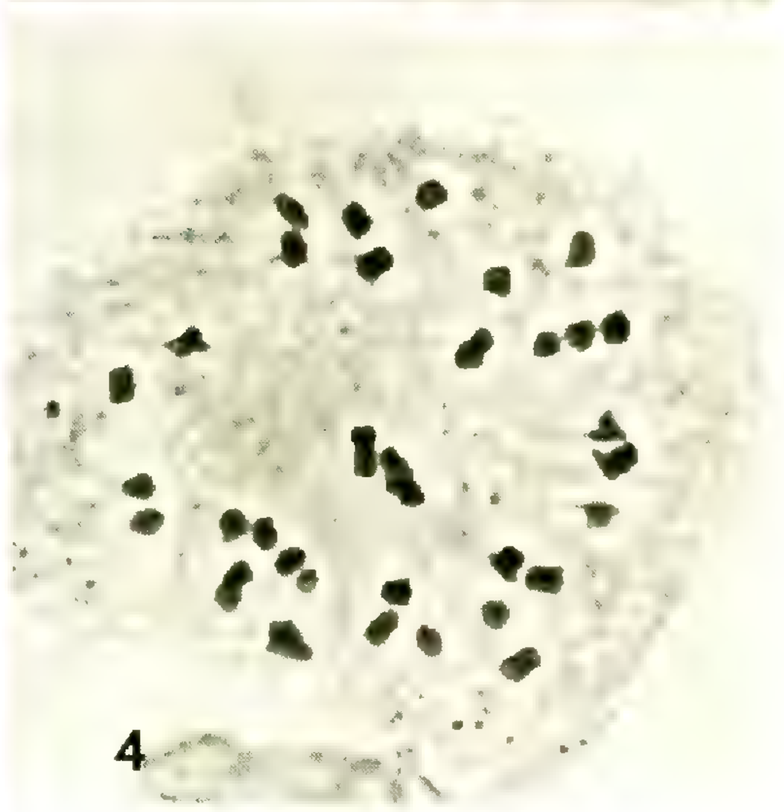
On a visit in 1970 the late Stanley Walker took some of my early *Sadleria* chromosome slides back with him to the University of Liverpool to see what he could make of the chromosome count. In a letter he wrote that he was quite certain the number was 35. In 1973 Trevor Walker (The University, Newcastle upon Tyne), referring to the family Blechnaceae, and specifically to the genus *Blechnum*, which has an aneuploid series of chromosome numbers from 28 to 36, wrote, "There is a suspicion that possibly the primitive number in the genus [*Blechnum*] is 33, this being found in *Brainea* and also in *Sadleria* as determined by myself from some preparations made by Professor [Irene] Manton. Chromosomes in *Blechnum* appear to have been gained or lost from this central number." No photograph or illustration accompanied this statement.

In published chromosome counts for the closely related genus *Blechnum* (Löve et al. 1977) the number $n = 33$ and the tetraploids based on this number, appear 18 times out of 94 published reports. The number $n = 34$ pairs plus tetraploids based on 34 appear twice as often, 36 times. One is tempted to speculate that in *Sadleria* the large chromosomes represent fusion products reducing 34 pairs to 33.

Reinterpretation of my older slides, bearing in mind the existence of one or more large chromosome pairs, indicates that 33 pairs is the meiotic number to be found in other species of the genus, e.g., *S. souleyetiana* (Gaud.) T. Moore and *S. pallida* Hook. & Arn., and likely will be found throughout the genus.




FIGS. 1–4. *Sadleria cyatheoides* and *S. quarrosa*. Fig. 1. *S. cyatheoides,* Oahu, Mt. Kaala. Fig. 2. Sporangium of *S. cyatheoides* showing 16 immature spores in four tetrads (*W. H. Wagner 84075*, West Maui). Fig. 3. Meiosis in *S. squarrosa* (*Hobdy 4250*, East Maui). Arrows indicate problem areas. Fig. 4. Meiosis in *S. squarrosa* (*W. H. Wagner 87163*, East Maui), $n = 33$ pairs.

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# TAXONOMIC NOTES ON THE PTERIDOPHYTES OF HAWAII

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In connection with a projected pteridophyte flora of Hawaii we have published fourteen new species and hybrids (W. H. Wagner 1993). In the present paper we report several additional new taxa as well as a number of combinations required by new developments in our knowledge of these plants and their nomenclature. Type specimens will be deposited at MICH and PTBG, and isotypes at other herbaria, including BISH.

## LYCOPODIACEAE

Analysis of the generic classification of Lycopodiaceae shows that there are a number of segregates that should be recognized as genera (cf. Holub 1983; Øllgaard 1987; W. H. Wagner & Beitel 1992). These genera have many distinguishing features, including comparative anatomy, basic chromosome numbers, spore wall structure, and gametophytic morphology. They are separated from each other by strong gaps in many characters, monophyletic uniquely derived states, inability to hybridize *inter se*, and a level of segregation consistent and comparable with modern generic divisions in other pteridophytes. Four of these genera occur in Hawaii: *Palhinhaea* (placed by some authors in *Lycopodiella*), *Lycopodium* s.s., *Huperzia* s.s., and *Phlegmariurus* (also placed in *Huperzia*). *Pseudodiphasium volubile* (G. Forster) Holub has been attributed to the Hawaiian flora, but this seems to have been an error.

One of Hawaii's rarest lycopods, **Phlegmariurus mannii** (Hillebr.) W. H. Wagner, comb. nov. [basionym: *Lycopodium phlegmaria* L. var. *mannii* Hillebr., Fl. Hawaiian Isl. 645. 1888; *Lycopodium mannii* (Hillebr.) Skottsb., Acta Horti Gothob. 15: 131–132. 1942] is apparently known only from the islands of Hawaii, Maui, and Kauai. It tends to grow on rough-barked trunks and boughs of trees, and is easy to overlook. This species is very similar to certain members of a tropical American group designated by Øllgaard (1987) as the subgroup of *Huperzia myrsinites* (Lam.) Trevisan. He gives its range as "Tropical America, Hawaii." **Phlegmariurus nutans** (Brack.) W. H. Wagner, comb. nov. [basionym: *Lycopodium nutans* Brack., U.S. Expl. Exped. Filic. 16: 327, t. 46. 1854; *Huperzia nutans* (Brack.) Rothm., Feddes

Repert. Spec. Nov. Regni Veg. 54: 62. 1944] is a rare and local species of special interest because of its sporangium-bearing tassels that are considerably less differentiated than in most members of the *Phlegmaria* group. Reported only from Oahu and Kauai, it is best known from the Koolau Mountains of the former island. Other new combinations needed are the following: **Phlegmariurus filiformis** (Sw.) W. H. Wagner, comb. nov. [basionym: *Lycopodium filiforme* Sw., J. Bot. (Schrader) 1800(2): 114; synonym: *Lycopodium polytrichoides* Kaulf., Enum fil. 6. 1824].

Of the ten Hawaiian members of the gemmiferous fir-moss genus, *Huperzia*, five are sterile hybrids. The latter are evidently capable of dispersal by modified deciduous shoots or gemmae that resemble samaras and are probably dispersed by wind. New collections are much needed. For example, there is a peculiar taxon on Kauai that resembles *H. serrata* (Thunb. ex Murray) Trevisan, but has smaller leaves with smooth margins and conspicuous "petioles"; it needs further investigation.

## GLEICHENIACEAE

Two species of *Dicranopteris* have traditionally been recognized in Hawaii. The glabrous one, "uluhe," *D. linearis*, is one of the most abundant fern species in the islands. It occurs usually in open, disturbed places, where it forms often extremely large beds that are hard to penetrate because of the numerous criss-crossing rachises. The ferruginous, woolly one, generally treated as *D. emarginata*, is much less common. In our experience, most of the differences alleged to characterize the two species are invalid. The only striking difference, that involving the presence or absence of pubescence, is highly unreliable, because all intermediate states are found. For this reason we regard the pubescent extreme as only a form, as follows: **Dicranopteris linearis** (N. Burm.) Underw. f. **emarginata** (Brack.) W. H. Wagner, comb. nov. [basionym: *Mertensia emarginata* Brack., U.S. Expl. Exped. Filic. 16: 297. 1854; *Dicranopteris emarginata* (Brack.) W. J. Robinson, Bull. Torrey Bot. Club 39: 240. 1912].

## HYMENOPHYLLACEAE

Of the ten species of filmy-ferns in Hawaii, one (a *Gonocormus*) is known in Hawaii only from the islands of Maui and Hawaii, and one (a *Vandenboschia* here described) is known only from Kauai. All of the others are more widespread.

The genus *Callistopteris* produces the most abundant gametophytes in Hawaii, according to D. R. Farrar. The local species is not sufficiently different to warrant its separation from *C. baueriana* (Endl.) Copel., originally described from Norfolk Island but now known to have a wide distribution. It is remarkably variable in Hawaii and traditionally has been identified as *C. baldwinii* (D. C. Eaton) Copel., based on original material found by D. D. Baldwin in 1878 in a valley on Oahu. In 1987 Farrar discovered a colony of plants, indistinguishable from the type (NY!), growing on mossy banks along the Upper Palolo Valley Trail. The only character that we can find to separate the type collection of *C. baldwinii* and the Farrar collection from the common Hawaiian plants, assigned to *C. baueriana*, is size; *C. baldwinii* reaches only 15 cm in height in contrast to *C. baueriana's* 55 cm. A more difficult taxonomic problem involves an element that occurs on Kauai. It is possible that it represents a distinct species, but there are intermediates. The following key will separate the two extremes.

Plants terrestrial; fronds upright, up to 55×15 cm; stipe usually straight at base and the rachis also straight; blade 3–4-pinnate; the segments 0.2–0.8 mm wide; involucres 0.9–1.2×1.0–1.3 mm. "Extreme 1": Segments narrow, sorus small (throughout the islands).

Plants on vertical moss-covered banks; fronds appressed, up to 15×9 cm; stipes usually bent at base and more or less twisted in upper part; blade 2–3-pinnate, the segments 0.4–1.1 mm wide; involucres mostly 1.3×2.2 mm. "Extreme 2": Segments broad, sorus large (Kauai only).

The most illustrative specimens of "Extreme 2" were found in the first large stream valley on Kilohana Trail beyond the end of the road (tributary of Kawaikoi Stream) in the Na Pali-Kona Forest Reserve, on vertical shaded mossy rock stream banks with *Sadleria unisora*, *Dryopteris tenebrosa*, and *Huperzia serrata*, 18 Aug 1947, *W. H. Wagner 5579* (MICH).

The following new species is known only from Kauai and until now apparently was confused with the similar filmy-fern *Vandenboschia davallioides* (Gaud.) Copel.

**Vandenboschia tubiflora** F. S. Wagner, sp. nov. Fig. 1.

*Vandenboschiae davallioidi* similis sed frondibus linearibus vel lineari-lanceolatis, lamina pallido-viridi, indusio tubulari basi truncato medio maxime dilatato orificio non vel minime expanso.

Creeping and climbing fern of the rain forest. Rhizome surficial long-creeping, 2–4 mm thick and covered with deciduous black and shiny appressed hairs, these up to 2 mm long, the upper 1 mm spreading. Roots few, small, 0.5–2.0 cm long and very narrow, arising near the leaf bases. Fronds linear to linear-lanceolate, up to 45×20 cm, 2–3-pinnate. Petiole 0.1–8.0 cm, narrowly winged, green, lacking trichomes. Rachis narrowly winged. Lamina 1 cell thick between veins, pale to medium green. Pinna pairs 16–23. Medial pinnae linear to linear-lanceolate, 3.5–5.0 times as long as wide, up to 7.5×1.5 cm. Basal pinnae reduced to 1/2–1/4 the length of medial pinnae. Pinnules lobed, the larger lobes apically cut into 2–5 narrow to very narrow projections. Venation free. Sorus marginal, arising singly on basal anterior segments of the pinnules. Paraphyses 0.8–1.2×0.4–0.7 mm. Indusium tubular, truncate, narrow at base, widening to maximum width in middle, not or only slightly flared at opening, sometimes inconspicuously 2-lipped.

HOLOTYPE: Kauai, Alakai Swamp Trail, 3700 ft, common on tree trunks in wooded areas, growing as a vine, 19 Jun 1964, *M. R. Crosby & W. R. Anderson 1484* (MICH).

ADDITIONAL SPECIMENS EXAMINED. KAUAI: Halemanu, 14–26 Feb 1907, *J. F. Rock 2277* (BISH). Lihue-Koloa Forest Reserve, nw of Wahiawa Bog along tributary of Wahiawa Stream, nw of stream and se of Hulua, wet forest dominated by *Metrosideros, Antidesma, Cyrtandra,* and *Athyrium*, epiphytic, 650–730 m, *T. Flynn et al. 2915* (BISH, PTBG). Kauhao, 800 m, *Faurie in 1910* (MICH). Hanapepe Falls, 300 m, *P. C. Hutchison 7340 & G. S. Daniels* (BISH, NY). Waiole Valley, *Forbes 95* (MICH). Waimea Drainage Basin, w side, Kauaikinana, *C. N. Forbes 1005,K* (BISH). Along Alakai Swamp Trail, 3700–4000 ft, 27 Oct 1956, *B. C. Stone 1514* (BISH); Kokee State Park, Kalua Puhi Trail, locally abundant, 28 Jul 1992, *W. H. Wagner 92131* (MICH).

The species dealt with here are commonly placed in the genus *Trichomanes* s.l. *Vandenboschia tubiflora* and *V. davallioides* correspond fairly closely with the New World tropical species pair, *Trichomanes* (*Vandenboschia*) *collariatum* van den Bosch [=*V. martinezii* (Rovirosa) Pichi Sermolli, *Trichomanes martinezii* Rovirosa] and *T.* (*V.*) *radicans* Sw. (cf. Mickel & Beitel, 1988, pp. 391, 395); the former has a flared indusium and the latter a truncate indusium. Vegetatively they are rather similar, but a complete resolution of their taxonomy must await a world-

FIG. 1. Holotype of *Vandenboschia tubiflora* (*M. R. Crosby & W. R. Anderson 1484*, MICH).

level monograph. *Vandenboschia radicans* (Sw.) Copel. is an almost worldwide tropical and subtropical species with many local variations; however, those specimens that we have seen appear to be coarser, with broader segments, than *V. tubiflora*. The two representatives of this group native to Hawaii may be readily separated as follows.

Indusia tubular, not or only slightly flared at apex; fronds mostly linear to linear-lanceolate; middle pinnae mostly 3.5–5.0 times as long as wide; Kauai. *V. tubiflora*.

Indusia tubular but conspicuously flared at apex, the flared portion 1.4–2.0 times the width of the tube; fronds mostly narrowly lanceolate to lanceolate-ovate; middle pinnae mostly 2–3 times as long as wide; on all the islands. *V. davallioides.*

## THELYPTERIDACEAE

The most common and conspicuous maiden fern in the Hawaiian islands is *Thelypteris cyatheoides* (Kaulf.) Fosberg. It is also one of the most variable species, difficult to segregate from its sister species. Within the *cyatheoides*-species-complex, habitats vary from flat forest floors to steep wooded hillsides, to vertical rock walls in the spray of waterfalls, to exposed shelves and crevices of rocks along streams. The rhizomes may be erect, climbing, or creeping, and vary in thickness from population to population, from less than 0.5 cm to 6.5 cm (including the armor of leaf bases on upright rhizomes). The color of the stem tissues is usually whitish or yellowish but may be bright purple. Rhizome scales may vary from linear to broadly lanceolate, and they may persist or be shed. Fertile frond length ranges from 5 to 200 cm. The axes may be scaly or glabrous. Pinnae vary from 0.8–4.5 cm in width; their shape may be lanceolate to linear, non-falcate to falcate. Veinlet pairs connected to the sinus vein may range from 1–10. The pinna margins may be cut into lobes 0.3–2.5 cm long or they may be entire. The basal pinnae may be unreduced or reduced when compared to the adjacent, more distal ones. The rachis may be nearly round on top to rather conspicuously sulcate. The veins and the lamina may be hairy or glabrous, and, if present, the hairs may be long or short. Golden glands are found in some populations, absent in others. The indusium may be absent or nearly absent or fully developed. If the last, it may be reniform or peltate, smaller than or larger than the mature sorus.

In the face of the enormous variability of the common *T. cyatheoides*, many factors must be recognized in designating species, among them the ability to grow with or near sister species, and the constancy and distinctness of characters and character complexes. The dwarf species *T. boydiae* (D. C. Eaton) Iwats., known thus far only from Oahu, Maui, and Hawaii, inhabits rocky places along streams. Hillebrand regarded it a variety of *T. cyatheoides* (var. *depauperatum* Hillebr., 1888). Holttum (1977) upheld it tentatively as a species but recommended its further study. *Thelypteris cyatheoides* also hybridizes with the naturalized *T. dentata* (Forsk.) E. P. St. John and forms the confusing sterile hybrid *T.* ×*palmeri* W. H. Wagner (1993). The hybrids occur widely on Oahu, but we have found so far only a single population on Kauai, a large population with perhaps a hundred individual plants over an area of ca. 6×6 m.

We also report two new species of *Thelypteris* here, both apparently endemic to Kauai. A key to the *T. cyatheoiodes*-complex is provided below.

**Thelypteris exindusiata** W. H. Wagner, sp. nov.

*Thelypteridi cyatheoidi* similis sed rhizomate longi-repenti purpureo-brunneo parenchymate purpurascenti, indusio vestigiali in soro vix visibili.

*Thelypteris exindusiata* is a large coarse fern resembling *T. cyatheoides* but differing from it usually in the following characters: rhizome purplish brown with purplish parenchyma, long-creeping and forming large clones; pinnae up to 25 pairs, nearly to entirely sessile, thin chartaceous; veins glabrous, hairy, or glandular; indusium vestigial so as to provide little or no protection and usually hardly or not visible.

HOLOTYPE. Kauai, Kealia Forest Reserve, along Makaleha Stream, locally abundant in shaded woods between trail and stream, 200 m, associated with *Deparia marginalis*, 27 Jul 1992, *W. H. Wagner et al. 92110* (MICH).

ADDITIONAL SPECIMENS EXAMINED. KAUAI: Wainiha Valley, stream below Hono-o-na-pali, on ground in *Hibiscus tiliaceus* thicket, 50 m, 31 Dec 1952, *K. A. Wilson 226* (BISH). Kipu, Haupu (Hoary Head Mts), wooded moist gulch, steep wooded slope, 215 m, 25 Dec 1933, *H. St. John & F. R. Fosberg 13648* (BISH). Wahiawa Mts, *C. N. Forbes 239K* (veins hairy; 3 sheets BISH). Haiku (Hoary Head Mts), Laaukahi, 400 m, on precipitous slope, 22 Dec 1933, *H. St John & F. R. Fosberg 13490* (BISH).

In general this is a species of low elevations, around 200 m. Thus far, we have not seen it growing side-by-side with *T. cyatheoides*, although such an association is to be expected.

**Thelypteris wailele** T. Flynn, sp. nov. Fig. 2.

Cataractas incolens; frondes angustae pendulaeque; pinnae basi truncatae, ascendentes, margine parum crenatae, apice longi-acuminatae; venae 1–3 paria per segmentum; indusia quam sori minora.

Plants epipetric near waterfalls. Rhizome slender, 2.5–4.0 mm in diameter (dry). Stipe dark brown at base, pale green above, 5.5–18 cm long. Lamina linear-oblanceolate, narrowed at the base with 1–4 pairs of reduced pinnae, 7.5–32 cm long, 3.8–13 cm wide. Pinnae with base truncate, lobed acroscopically, the margin shallowly crenate, apex long acuminate. Costules 2.5 mm apart, veins 1–3 pairs; both sides glandular; margin, veins and costules with linear-oblanceolate scales to subglabrous to glabrous. Sori subcostal to medial at base of pinnae; indusia round, sub-peltate to reniform with few to several scales.

HOLOTYPE: Kauai, Hanalei District, Waioli Valley, on sheer rock face in spray of waterfall, 457 m, 5 Nov 1992, *T. Flynn, D. Lorence & S. Perlman 5130* (PTBG; isotypes: BISH, MICH, US, Palmer Herb.).

ADDITIONAL SPECIMENS EXAMINED. KAUAI: Waioli, back of valley below Namolokama, 439 m, 4 Nov 1992, *S. Perlman et al. 13096* (PTBG) (this collection is from the type locality). Hanging valley above main falls, 550 m, 19 Nov 1993, *K. R. Wood 2141* (MICH, PTBG); 23 Jul 1909, *C. N. Forbes 84K* (BISH). Wainiha, back of valley below Hinalele Falls, 770 m, 29 Jan 1993, *K. R. Wood et al. 2334* (PTBG). Hanalei, back of valley below Pohakupele, headwaters of the Hanalei River, 620 m, 22 Mar 1993, *K. R. Wood 2445* (PTBG); on sheer, dripping wet walls at back of valley along waterfall, 713 m, 22 Mar 1993, *T. Flynn 5319* (AD, BISH, MICH, PTBG, US). Waimea District, Koaie Canyon, 3080 ft, 31 Aug 1994, *K. R. Wood & S. Perlman 3461* (BISH, MICH, NY, PTBG, US).

The epithet for this species is the Hawaiian word for waterfall and refers to the habitat, usually on a sheer rock face, at the margins of falls in the spray zone. This rather striking fern is easily recognizable by its narrow, pendent fronds and slender, creeping rhizome. It was first collected in 1909 in Waioli Valley on the north shore of Kauai by C. N. Forbes, and then not again until 1992 in the same valley.

## KEY TO THELYPTERIS CYATHEOIDES COMPLEX

1. Mature fronds up to 1 m or more long; soriferous pinnae up to 8–15 cm long; rachis 2–5 mm thick.
   2. Rhizome and lower stipe surface straw-colored (alive); internal parenchyma cells white to yellowish; pinnae up to 35, short-stalked (up to 1 mm), coriaceous; indusium conspicuous, usually covering sorus; occurring on all the islands, morphology highly variable.

*T. cyatheoides.*

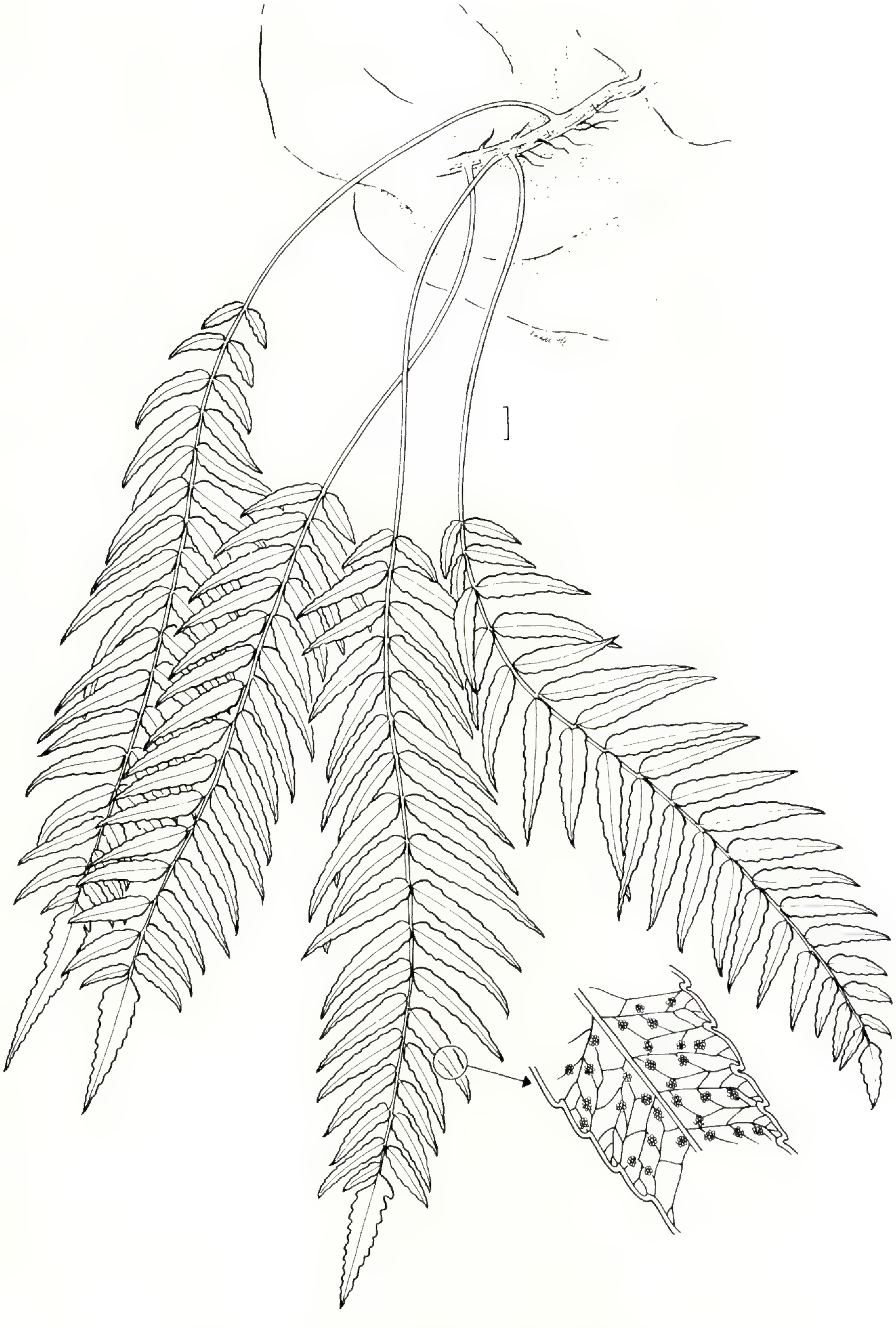

FIG. 2. *Thelypteris wailele*, based on the holotype.

2. Rhizome and lower stipe surface purplish brown, internal parenchyma cells purplish; pinnae up to 25, nearly sessile, chartaceous; indusium vestigial, in mature sori usually not apparent to the naked eye; Kauai, locally common at lower altitudes, morphology uniform. *T. exindusiata.*

1. Mature fronds mostly less than 0.5 m long; largest soriferous pinnae 3.5–7 cm long; rachis 0.8–1.4 mm thick.

3. Fronds stiffly upright; rhizome erect; middle and upper pinnae tips rounded, ending more or less abruptly, weakly ascending; indusia broader than sori; Oahu, Maui, Hawaii, on rocks and ledges along streams. *T. boydiae.*
3. Fronds loosely pendent; rhizome long-creeping; middle and upper pinnae ending in long-attenuate tip; strongly ascending; indusia only 1/2–2/3 as broad as sori; Kauai, on sheer rock faces at the margins of falls in the spray zone. *T. wailele.*

## ASPLENIACEAE

The genus of spleenworts, *Asplenium* s.l., is the largest in number of species (a total of 20 varieties and sterile hybrids are excluded) of all the Hawaiian fern genera. Worldwide, the genus is credited with approximately 600 species, and a number of small related but very distinct genera have been amalgamated with it over the past 50 years. The genus is noted for the capacity to produce interspecific hybrids, including many between morphologically very different parents. It is also noted for its sometimes very subtly differentiated species. Occasionally striking sporadic forms appear, especially ones with unusually divided fronds.

The genus *Diellia* Brack. is one of the most interesting groups in the islands due to its extreme variability and the great rarity of most of its species. It was recently reduced to synonymy under *Asplenium* L. by R. Viane (Viane & Reichstein 1992). However, along with several other groups of *Asplenium* s.l., we believe that *Diellia* merits generic recognition. One of its species, as we construe it, is prototypic in the sense that its sori are not submarginal and pointing outward; however, all of its other characters coincide closely with those of the other species, and for this reason we propose the the following new combination: **Diellia leucostegioides** (Baker) W. H. Wagner, comb. nov. [basionym: *Asplenium leucostegioides* Baker, Ann. Bot. 5: 302. 1891]. It was found in East Maui before 1879, but has not been collected since, although it may still occur there. It may possibly be confused with *Asplenium normale* Don unless examined carefully. The characters that are shared by all the species of *Diellia* are the entire-margined pinnae, sessile and overlapping the rachis, the widely spaced veins, the short sori (except for partially fused coenosori in some species), and the peculiar, appressed, apparently unique two-celled gametophytic trichomes. There is no question that all six of the species now included in *Diellia* are monophyletic.

In Kauai, one of the spectacular endemics, the feathery, highly divided *Diellia mannii* (D. C. Eaton) W. J. Robinson, has apparently not been collected since the last century. A note in the Bishop Museum from A. S. Knudsen in 1914 reads, "*Diellia mannii* very rare. It has all disappeared from the Halemanu Mountains." Nevertheless, considering their recent good fortune in rediscovering other rarities, field botanists should keep this fern in mind. The other Kauai endemic, *D. pallida* W. H. Wagner (1993) [formerly misidentified as *D. laciniata* (Hillebr.) Diels], still exists in two small populations, one in Koai'e Canyon, 4 plants, at ca. 600 m in bare soil on a steep slope with *Antidesma, Electryon, Rauvolfia, Melia, Acacia koa,* and *Lantana* (*Lau 3100* in 1987, BISH). The other population is in Mahanaloa Valley at ca. 670 m on the trail from Milolii Ridge into Paaiki Valley and into Mahanaloa, under a canopy of *Diospyros* and *Pisonia*, on sloping dry rocky terrain, 10 plants, 10 July 1991, *J. Obata & S. Perlman s.n.* (BISH). Considering its rarity every effort should be made to preserve its habitats. All except one of the six *Diellia* species are known only from single islands: Kauai, *D. mannii* and *D. pallida*; Oahu, *D. falcata* Brack. and *D. unisora* W. H. Wagner; and Maui, *D. leucostegioides*. Only *D. erecta* is found on all the high islands.

Following are two new taxa of *Asplenium*, one a fertile orthospecies, the other a sterile nothospecies.

**Asplenium neobrackenridgei** W. H. Wagner, sp. nov. Fig. 3.

*Asplenium contiguum* Kaulf. var. *hirtulum* C. Christensen, Bernice P. Bishop Mus. Bull. 25: 27. 1925 (holotype: unknown).

*Asplenio contiguo* similis, sed squamis rhizomatis tegentem brunneam lanatam formantibus, segmentis anticis pinnae subtiliter serrulatis, pinnis versus apicem gradatim angustatis, lamina axibusque pilis glandulosis eglandulosisque dense tectis, 1–4 cellulas longis.

HOLOTYPE: Kauai, Kokee, Pihea Trail, 9 Apr 1987, *W. H. Wagner 87180* (MICH).

ADDITIONAL SPECIMENS EXAMINED. KAUAI: Robinson summer home, 800 m, 1910, *L. Faurie 315* (CA). Pihea Trail from Puu o Kila to Alakai Swamp Trail, terrestrial along trail in swamp, 14 Aug 1992, *J. Montgomery 9294* (private collection). Island not stated: Standard Species ex Herb D. D. Baldwin, Kokee, Pihea Trail, 9 Apr 1987 (MICH).—MAUI: East Maui, middle Waikamoi Forest along road to flume trail, common on mossy tree trunks, with eglandular form, all stages juvenile to adult, ca. 1300 m, 27 Mar 1987, *W. H. Wagner 87155a* (MICH).

The following key compares it with the sister species *A. contiguum.* The first lead also serves as the English description of *A. neobrackenridgei.* It may grow together with or nearby *A. contiguum*, allowing comparisons to be made in the living state. Intermediates are unknown.

Basal scales forming a medium brown woolly mass; anterior pinna segments finely dentate-serrulate, the teeth mostly narrowly pointed; pinnae with mostly gradually narrowed tips; lamina and axes densely covered with glandular and non-glandular hairs, 1–4 cells long; sori 2–7 mm long; Kauai and Maui, in rain forests, rare and local. *A. neobrackenridgei.*

Basal scales forming a dark brown to nearly black flat imbricate mass; anterior pinna segments dentate, the teeth mostly rounded; pinnae mostly with long-acuminate narrow tips; lamina and axes glabrous except for scattered fibrils; sori 4–10 mm long; occurring on all islands, in dry to wet forests, common and widespread. *A. contiguum.*

**Asplenium ×kokeense** W. H. Wagner, hyb. nov. Fig. 4.

Inter *A. aethiopicum* et *A. cookii* intermedia; rhizoma repens; squamae usque ad 6 mm longae; frons usque ad 80 cm alta, (1–) 2-pinnata; pinnae anguste triangulares; pinnulae basales late acutae; lamina margine dentata vel grosse serrata; sporae abortivae.

Intermediate between A*splenium aethiopicum* (N. L. Burm.) Becherer [synonym: *A. praemorsum*] and *A. cookii* Copel. (in Hawaii the name *A. polyodon* has been misapplied to the latter species). Rhizome creeping, the scales ± 6 mm long. Frond to 80 cm tall, 1–2-pinnate. Pinnae narrowly triangular, the basal pinnules broadly pointed, the margins variable from broadly dentate to coarsely serrate. Spores abortive.

HOLOTYPE: Kauai, Kokee, Waineke Swamp, one huge sterile clone growing at weedy swamp edge with parents, 11 Apr 1987, *W. H. Wagner 87198* (MICH).

ADDITIONAL SPECIMEN EXAMINED. OAHU: Waianae Mts, Makaha–Waianae Kai, Puu Kaawewe–Puu Kaala Ridge, 31 Mar 1935, *F. R. Fosberg 10846* (BISH).

This nothospecies will probably be revealed to have many more populations. The parents, especially *A. cookii*, are common, and once formed the hybrid is

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FIG. 3. Holotype of *Asplenium neobrackenridgei* (*W. H. Wagner 87180*, MICH).

FIG. 4. Holotype of *Asplenium ×kokeense* (*W. H. Wagner 87198*, MICH).

capable of producing large and vigorous clones. The following key will separate the hybrid from the parents.

1. Fronds mostly 1-pinnate; secondary segment tips crenate (when present); basal segments linear to linear-rhomboidal; spores normal. *A. cookii.*
1. Fronds mostly 2-pinnate; secondary segments tips irregularly dentate to deeply incised; basal segments rhomboidal to subflabellate; spores normal or abortive.
   2. Middle and upper pinnae pinnate 3–5 times as long as broad; segments narrowly rhomboidal, distally crenate to dentate or serrate, not or slightly cleft. *A. ×kokeense.*
   2. Middle and upper pinnae 1 1/2–2 1/2 times as long as broad; segments subflabellate, distally deeply serrate, usually more or less cleft. *A. aethiopicum.*

## DRYOPTERIDACEAE

A number of Hawaiian fern species are noted for unusual soral arrangements that deviate considerably from those in related species. There seems to be a strong tendency toward marginward migration of the sori (e.g., *Grammitis baldwinii* vs. *G. hookeri*, *Diellia erecta* vs. *D. leucostegioides*, *Dryopteris parvula* vs. *D. glabra*). More striking is the tendency for the sori to become stalked, e.g., marginally, *Deparia prolifera* stalked vs. non-stalked forms of the same species, and, dorsally, *Dryopteris soripes* vs. *D. glabra*. The most remarkable stalked-sorus species as yet found in Hawaii is a newly discovered one that occurs on steep, mossy walls of rain forest stream valleys near the Alakai Swamp in Kauai. In this previously undescribed species the sori are dorsal but stalked, the stalks 0.8–1.3 mm long. When the living frond is lightly shaken the sori jiggle. The most similar soriation known to us is that of species of the genus *Peranema,* which ranges from India to Malesia (cf. *P. cyatheoides* Don, Kramer, p. 109, fig. 48J). The new species appears grossly like a young *Cibotium* growing from a nearly vertical mossy wall. Its nearest relative is apparently *D. crinalis,* and its description is given in table 1 comparing them. The new species is very rare, and every effort should be made to preserve this remarkable fern. The right-hand column in the comparison chart below will serve as the English description.

**Dryopteris podosora** W. H. Wagner & T. Flynn, sp. nov. Fig. 5.

*Dryopteridi crinali* similis sed stipite pinna 2–3plo breviore, lamina plerumque 2-pinnata, venulis infernis segmentorum plerumque 1–2-ramosis, soris exindusiatis globularibus stipitatis stipitibus 0.8–1.3 mm longis.

Holotype. Kauai, Waimea District, Kauaikinana Stream, W of Pihea Trail, Alakai Swamp Trail, shaded wet mossy wall above stream, 28 Jul 1992, *W. H. Wagner 92115* (MICH).

Additional Specimens Examined. Kauai: Kauaikinana Stream W of Pihea Trail (type locality), 28 Jul 1992, *T. Flynn et al. 5091* (BISH, PTBG). 200 m from Alakai Swamp Trail crossing stream from Mohili Stream, steep, dark, damp slope, with *Sadleria unisora, Cibotium glaucum*, and *C. menziesii*, 16 Nov 1992, *D. D. Palmer & T. Flynn 1026* (Palmer Herb.)

*Dryopteris parvula* W. J. Robinson (1912) is a nomen novum based on *Aspidium glabrum* var. *pusillum* Hillebr., Fl. Hawaiian Isl. 577. 1888. The name *Dryopteris pusilla* was preoccupied by *Dryopteris pusilla* (Mett.) Kuntze. The original plants of *D. parvula* were collected on "Kauai. 5000–6000 ft. (Kn[udsen] and E. Johnson)" according to Hillebrand (1888). Except for Robinson, all authors have apparently

Table 1. Comparison between *Dryopteris crinalis* and *D. podosora.*

| | *D. crinalis* | *D. podosora* |
|---|---|---|
| Habitat | wet shaded slopes and banks | steep dark mossy walls |
| Frond orientation | mainly pendent | upright, spreading (like juvenile *Cibotium*) |
| Stem | short, upright | short, upright |
| Scales | 0.4–1.5×0.2–1.0 cm | 0.3–1.2×0.04–0.8 cm |
| Fibrils along axes | blackish, extremely narrow, only 0.05–0.1 mm wide; mostly 1–2 cells wide in outer half; bases not strongly dilated; cells linear | brown, narrow, mostly 2–5 cells wide in outer half; bases commonly strongly dilated; cells oblong to square |
| Blade | attenuate deltate; 15–45×7–28 cm; 8–12× as long as wide | elongate deltate; 12–35×7–26 cm; 2–8× as long as wide |
| Stipe | mostly 1/4–1/3 as long as blade | mostly 1/2–1/3 as long as blade |
| Blade cutting | 2–3-pinnate | 2(–3)-pinnate |
| Apical lobes | rounded or slightly toothed | angular with apical low cartilaginous teeth |
| Lower veinlets on segments | mostly 0–1-branched | mostly 1–2-branched |
| Costal trichomes | black, linear, few linear cells wide | mostly reddish brown, triangular, attenuate, many elongate-oblong cells wide |
| Sori | dorsal, hemispherical, not stalked | dorsal, globular on narrow non-chlorophyllous vascularized stalks 0.8–1.3 mm long |
| Indusium | exindusiate | exindusiate |

ignored this species since its original discovery probably sometime before 1880. It was not rediscovered until Timothy Flynn, in 1992, found a large and dense population growing at the base of a shaded, mossy, wet wall, just above a stream in a deep ravine, west of Pihea Trail, along the Alakai Swamp Trail. We visited the locality under his guidance in July, 1992, and can state without qualification that it is not a variety or form of *Dryopteris glabra* but instead a well-differentiated species. Furthermore, it grows to be much larger than originally described; the stipe reaches up to 25 cm, the blade to 30 cm long (Figs. 6, 7). A preliminary key is given below to separate *D. parvula* from the abundant and highly variable *D. glabra.*

Rhizome scales sparse, 5–9 mm long; blade narrowly triangular, 2–3 times as long as broad; lower stipe glabrous; color (alive) pale green; axes narrow, mostly 1–1.5 mm thick, wiry; tertiary segments mostly 1–3 mm wide except for anterior basal lobe, which is usually exaggerated; tips commonly truncate to emarginate; frond and pinna apices mostly subattenuate; sori marginal to submarginal. *D. parvula.*

Rhizome scales abundant, 8–12 mm long; blade broadly triangular, 1–2 times as long as broad; lower stipe commonly scaly; color (alive) medium green; axes broader, mostly 1.5–2.5 mm thick, stiff; tertiary segments mostly 2.5–5.0 mm wide, the anterior basal lobe conform; tips usually rounded to truncate; frond and pinna apices conform; sori submarginal to dorsal. *D. glabra.*

FIG. 5. Holotype of *Dryopteris podosora* (*W. H. Wagner 92115*, MICH).

FIG. 6. Specimen of *Dryopteris parvula* with small fronds (*W. H. Wagner 92117*, MICH).

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FIG. 7. Large fronds of *Dryopteris parvula* (*W. H. Wagner 92117*, MICH).

## GRAMMITIDACEAE

The two genera, *Oligadenus* and *Adenophorus*, studied by L. E. Bishop (1974) show glandular paraphyses in their sori but otherwise are quite different, as shown in the following key.

Blades simple to pinnatifid or pinnatisect; hairs non-glandular to glandular on lamina surfaces; clone formation by root proliferations (4 species, 2 nothospecies). *Oligadenus*.
Blades compound, bipinnatisect to tripinnatisect; glands appressed on laminar surfaces; clone formation by rhizomes (7 species, 2 nothospecies). *Adenophorus*.

Separation of these two genera is additionally supported by the fact that interspecific hybridization is now known within each but is absent between them. Before his premature death, Earl Bishop was working on the generic problems in Grammitidaceae; since then, the research has been continued by Alan R. Smith and Robbin C. Moran. The conclusion reached is that past generic delimitation in this family was in general too broad. For example, the former genus *Grammitis* is now considered to comprise a number of distinct, well-marked, generic elements.

A collection treated by Bishop as a variety of *Adenophorus tamariscinus* should be considered as a distinct sister species, **Adenophorus epigaeus** (L. E. Bishop) W. H. Wagner, comb. nov. [basionym: *Adenophorus tamariscinus* var. *epigaeus* L. E. Bishop, Brittonia 26: 226. 1974]. The sorus of *A. epigaeus* is dorsal (rather than apical on the pinnule). Its rhizome is long-creeping and slender (rather than short-creeping and stout); the fronds are remote (rather than close) and sublinear, and the plants are terrestrial in mosses (rather than epiphytic). Typical populations of *A. epigaeus* are known only from Kauai.

Another new combination is as follows: **Adenophorus montanus** (Hillebr.) W. H. Wagner, comb. nov. [basionym: *Polypodium tamariscinum* Kaulf. var. *montanus* Hillebr., Fl. Hawaiian Isl. 556. 1888]. This species has a short-creeping rhizome and is usually epiphytic; the sori are terminal. It is best represented in Maui but is absent from Kauai.

The first known interspecific hybrid in the genus *Adenophorus* was the recently described *A.* ×*carsonii* T. A. Ranker (1993). It involves two very different parents, A. *hymenophylloides* and *A. tripinnatifidus*, which were found growing near each other on mossy trunks of ohia lehua in the Puna District on the island of Hawaii. We herewith describe another hybrid, this one from Kauai.

**Adenophorus** ×**abbottiae** W. H. Wagner, hyb. nov. Fig. 8B.

Inter *A. hymenophylloides* (Fig. 8A) et *A. tamariscanum* (Fig. 8C) intermedia; frondes patentes, usque ad 7.7 cm longae; pinnae usque ad 19 paria, 0.9 cm longae, aliquantum dimidiatae, pinnula antica basali aliquantum aucta; pinnulae anticae 2–4, elongati-spatulatae; sporae parum irregulares, sine pigmento.

HOLOTYPE: Kauai, Waimea District, above Kauaikinana Stream, Pihea Trail, small patch in dense moss on fallen old ohia trunk, near parents, 28 Jul 1993, *W. H. Wagner 92120* (MICH).

The specific epithet honors Professor I. A. Abbott, noted Hawaiian botanist and phycologist, whose enthusiasm and knowledgeable help contributed much to our studies.

*Adenophorus* ×*abbottiae* is compared to its associated parents in table 2. Hybrids involving *A. hymenophylloides* as one parent are easily detected because of its

Table 2. Comparison of small fronds of *Adenophorus hymenophylloides* (*W. H. Wagner 92130c*), *A. ×abbottiae* (*W. H. Wagner 92130b*), and *A. tamariscinus* (*W. H. Wagner 92130a*). Vouchers are deposited at MICH.

| | *A. hymenophylloides* | *A. ×abbottiae* | *A. tamariscinus* |
|---|---|---|---|
| Rhizome | long-creeping | creeping | upright, tufted |
| Leaf orientation | pendent, soft | spreading | upright, rigid |
| Blade | 0.5–6.0×0.4–0.5 cm | 2.0–6.5×0.8–1.7 cm | 3.1–7.0×0.9–1.9 cm |
| Stipe length | 0.3–0.5 cm | 0.6–1.2 cm | 1.0–1.9 cm |
| Trichomes | 0.08–1.0 mm | 0.2–0.4 mm | 0.3–0.6 mm |
| Pinna length | 0.2–0.3 cm | 0.3–0.9 cm | 0.8–1.2 cm |
| Number pinna pairs | up to 24 | up to 19 | up to 16 |
| Shape | dimidiate | somewhat dimidiate | not dimidiate |
| Basal anterior pinnule | enlarged | slightly enlarged | equal to adjacent pinnule |
| Glands on mature axes and abaxial lamina | abundant, obliquely raised, hyaline; up to ca. 0.02 mm long | common; slightly raised; hyaline, pale tan; up to ca. 0.03 mm long | scattered; tightly appressed; golden; up to ca. 0.4 mm long |
| Pinnule number (anterior side of pinnae) | 1–2 | 3–4 | 6–8 |
| Pinnule shape | spatulate | elongate-spatulate | linear-oblong |
| Spores | normal; green | somewhat irregular; unpigmented | normal; green |

unique morphology. Botanists are urged to search for less obvious hybrids involving other species pairs, especially to determine whether or not they are sterile. The plants involved were all growing within a few feet of each other, and all appeared to be somewhat dwarfed; the parents are known to reach 3–4 times the size of those described here, so the hybrid can probably also reach much larger dimensions.

## POLYPODIACEAE

A. R. Smith and K. A. Wilson brought to our attention a problem involving the abundant local invasive species that we have been calling *Phymatosorus scolopendria* (L. Burm.) Pichi Sermolli. Apparently this name has been used wrongly to apply to the widespread species of the Pacific that has now spread extensively into horticulture and has become naturalized in many areas (Brownlie 1977) as it has in Hawaii, where it is perhaps now the most abundant of the local pteridophytes. The true *P. scolopendria* is of smaller stature than the Hawaiian taxon, is less widely distributed, and has not been found in Hawaii. The local species is *P. grossus* (Langsd. & Fischer) Brownlie. They may be distinguished as follows (both species, when juvenile or dwarfed, may be unlobed).

FIG. 8. *Adenophorus* ×*abbottiae* and its parent species *A. tamariscinus* and *A. hymenophylloides* (all ×0.85). A. *A. tamariscinus* (*W. H. Wagner 92125*, MICH). B. *A.* ×*abbottiae* (*W. H. Wagner 92126*, MICH). C. *A. hymenophylloides* (*W. H. Wagner 92127*, MICH).

Plants primarily terrestrial; fronds up to 70 cm tall; lateral lobes in full-sized plants 7–11 pairs, to 15 cm long, narrowing near base, rounded to somewhat pointed, leathery. *P. grossus.*
Plants primarily epiphytic; fronds up to 30 cm tall; lateral lobes in full-sized plants only 2–4 pairs, to 10 cm long, broadest at base; acuminate, chartaceous. *P. scolopendria.*

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# BENTHIC MARINE ALGAE FROM THE SEYCHELLES COLLECTED DURING THE R/V *TE VEGA* INDIAN OCEAN EXPEDITION

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## INTRODUCTION

The Seychelles are an island group located in the central western Indian Ocean and in comparison to neighboring regions, such as Mauritius, India, and the east coast of Africa, have until recently remained relatively little known in respect to the benthic marine algal flora. Reinbold (1907) listed a total of 40 taxa of marine algae, including cyanophytes, from Mahé Island and described *Griffithsia schimperi* and *Corallopsis concrescens* as new species. Other early workers, namely, Gepp and Gepp (1908, 1911), and Weber-van Bosse (1913b), barely touched on collections made in the Seychelles. Wynne (1970a, 1970b) described *Rhodolachne* from the Seychelles. Price's (1971) treatment of the shallow sublittoral ecology of Aldabra included a number of algal taxa, although many were identified only to the generic level. Segonzac (1984) listed a dozen taxa of crustose calcareous Rhodophyceae (mostly Corallinaceae) as well as *Avrainvillea erecta* (Berkeley) A. Gepp & E. S. Gepp and *Halimeda macroloba* Decaisne of the Chlorophyceae as occurring in the Seychelles. Titlyanov and Butorin (1978), Aleem (1984), and Untawale and Jagtap (1989) also added to our knowledge. Littler and Littler (1990) reported *Rhipidosiphon javensis* Montagne from the Seychelles. Mshigeni (1985, 1987a) and Mshigeni et al. (1987) contributed lists of benthic marine algae of the Seychelles that focus on possible economic utilization. Based on a note in Farlow's handwriting, Sayre (1969) asserted than an exsiccata purportedly comprised of Seychellois algae, "Algues des Seychelles (Ocean Indien) determinées par Dr. Ed. Bornet" (W. Steicher, Paris, 1889), was "fraudulent." It was alleged that the provenance of the specimens in this exsiccata was probably Réunion rather than the Seychelles. A lengthy species list of the algae and seagrasses, accompanied by much information on the local distribution and the abundances of the species, has been published by Kalugina-Gutnik et al. (1992), repeated in Titlyanova et al. (1992), in connection with a joint USSR–USA expedition to the Seychelles Islands in early 1989.

The Seychelles Archipelago represents a heterogeneous assemblage of high granitic islands and low carbonate islands. Littler et al. (1991) have pointed out that nitrogen and phosphorus are much less limiting to photosynthesis in the nearshore waters of the high granitic islands than those associated with low carbonate islands. Their studies revealed that the high granitic islands of the Seychelles were characterized by large and species-rich standing stocks of frondose macroalgae, often dominated by species of *Sargassum*, whereas the waters surrounding the low carbonate islands were usually dominated by hermatypic corals.

Collections of benthic marine algae were made in 1964 during the author's participation in Cruise No. 5 of Stanford University's *Te Vega* Expeditions. A list of species compiled for the Maldives during this Expedition has been published previously (Wynne 1993). A list of species of marine algae identified from the Seychelles is presented in this account, accompanied by pertinent remarks concerning some of the taxa. A total of 119 taxa[1] are recorded herein, including 80 Rhodophyta, 15 Phaeophyta, and 24 Chlorophyta. An asterisk preceding the name of the taxon indicates that this record represents the first report from the Seychelles. The non-geniculate coralline red algae and species of *Sargassum* from my collections have not yet been studied in detail.

## MATERIALS AND METHODS

The *Te Vega* Expeditions were a series of oceanographic studies supported in part by the U.S. National Science Foundation (Grant No. G17465, Dr. D. P. Abbott, Chief Scientist). The benthic algae were obtained mostly by snorkeling in shallow-water habitats, less often at greater depths by SCUBA-diving participants. A list of the collection sites, dates, and other information is given in the Appendix. Collections were made only from the high granitic islands of the Seychelles Archipelago rather than from the low carbonate islands (Littler et al., 1991).

The algae were either preserved in 5% formalin–seawater or processed as herbarium specimens. Much of the wet-preserved material was later sorted out and mounted (in toto if small, or as sectioned material if larger) onto glass microscope slides. These microscope preparations were ringed with Karo corn syrup and allowed to solidify. Since with time most of the wet-preserved specimens were bleached, a mixture of 1% aniline blue/1 M HCl/Karo syrup/tap water (4:1:20:75) was used to stain the specimens. All of the taxa cited in this paper have been deposited in the form of either herbarium specimens or microscope-slide mounts in the Herbarium of the University of Michigan, Ann Arbor (MICH).

## LIST OF TAXA

### RHODOPHYTA

#### Compsopogonales

#### Erythropeltidaceae

**Erythrotrichia carnea** (Dillwyn) J. Agardh (1883).

Basionym: *Conferva carnea* Dillwyn (1807).

Collection: 3S–36.

Previous Seychelles record: Kalugina-Gutnik et al. (1992).

This small alga was observed as an epiphyte on *Cladophora vagabunda* (Linnaeus) van den Hoek. The species has a cosmopolitan distribution.

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[1]This figure is based on identifications to species or subspecific taxa. Determinations only to genus are excluded.

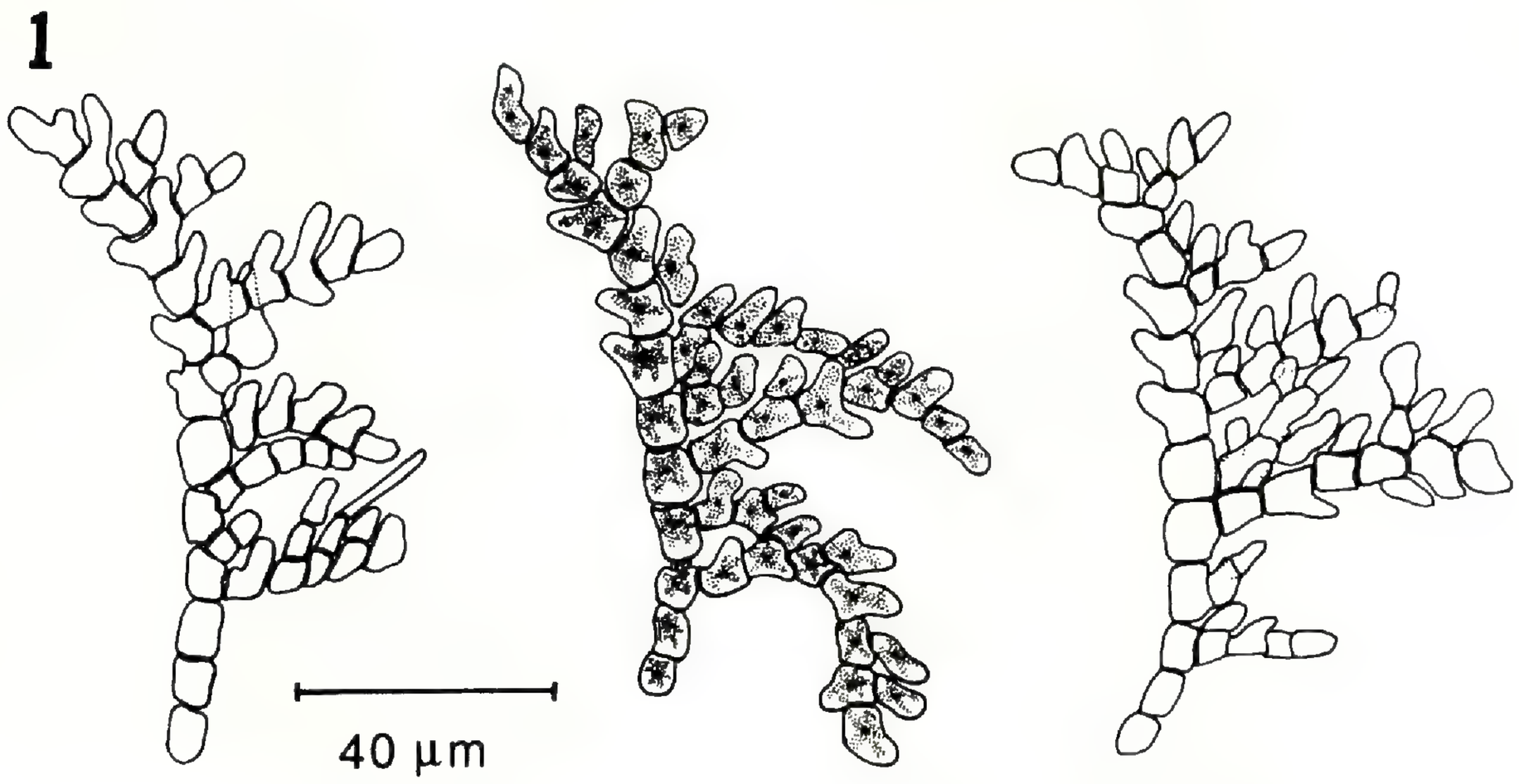



FIG. 1. *Audouinella microscopica* (3S–44). Examples of thalli, showing arcuate main axis and secund branching pattern.

## NEMALIALES

### Acrochaetiaceae

**Audouinella microscopica** (Nägeli in Kützing) Woelkerling (1971). Fig. 1.
Basionym: *Callithamnion microscopicum* Nägeli in Kützing (1849).
Collection: 3S–44.

Previous Seychelles record: Kalugina-Gutnik et al. (1992, as *Chromastrum crassipes*).

This small epiphytic alga is attached to its host *Gelidiella lubrica* (Kützing) Feldmann & Hamel by a single basal cell. The basal cell is scarcely distinguishable from the other cells, in agreement with the account of this species by Drew (1928, as *Rhodochorton microscopicum*). The thalli reach only 80–90 µm in height and have an arching aspect with mostly secund branching. There is a single stellate chloroplast with a conspicuous pyrenoid per cell (Fig. 1b).

*Chromastrum crassipes* (Børgesen) Papenfuss is generally regarded as a taxonomic synonym of *A. microscopica* (Woelkerling 1972; see, however, Stegenga & Mulder 1979). It was depicted from India by Børgesen (1931, as *Acrochaetium crassipes*) and more recently from the southeastern United States by Schneider and Searles (1991). Whether the family Acrochaetiaceae should comprise a single genus, *Audouinella*, as advocated by Dixon and Irvine (1977) and Garbary (1979), or five to seven genera, as advocated by Stegenga (1979), remains unsettled. Desikachary et al. (1990), using the name *Kylinia microscopica* (Nägeli) Kylin for this taxon, recognized three genera in the family: *Audouinella* as a freshwater genus, and *Kylinia* and *Acrochaetium* as marine genera; *Kylinia* was distinguished by the plants having a single prominent basal cell and *Acrochaetium* by the plants having a well-defined prostrate disc. These taxonomic problems have been reviewed in Silva et al. (1987).

***Audouinella subseriata** (Børgesen) Garbary (1987).
Basionym: *Acrochaetium subseriatum* Børgesen (1932b).
Collection: 3I–31.

This alga was present as small tufts (1 mm tall), forming a fuzzy growth over coral. The basal system of this alga consisted of short, irregularly branched creeping filaments. Monosporangia were borne in a seriate arrangement on the upper sides of the erect branches. Børgesen (1932b) stated that this species is most closely related to *Acrochaetium seriatum* Børgesen, a species originally described from the West Indies but reported from the Seychelles by Kalugina-Gutnik et al. (1992).

## Dermonemataceae

**Dermonema frappieri** (Montagne & Millardet) Børgesen (1942b). Fig. 2.

Basionym: *Cladosiphon frappieri* Montagne & Millardet (1862).

Collection: 3B–2.

Previous Seychelles records: Mshigeni (1987b), Untawale & Jagtap (1989).

This alga typically occurs in surf-exposed conditions; it was attached to boulders in the lower littoral zone. Thalli are noncalcified and have a firm gelatinous texture. This species is also known from India (Desikachary et al. 1990), Sri Lanka (Svedelius 1939, as *D. gracile)*, Mauritius (Børgesen 1942b), China (Tseng 1983), Taiwan (Lewis & Norris 1987), the Philippines (Cordero 1977), Japan (Yoshida et al. 1990), Vietnam (Dawson 1954a), and New Guinea (Weber-van Bosse 1921, as *D. gracile*).

## Galaxauraceae

*__Actinotrichia fragilis__ (Forsskål) Børgesen (1932a).

Basionym: *Fucus fragilis* Forsskål (1775).

Collection: 3S–33.

Børgesen's (1932a) assignment of *Actinotrichia rigida* (Lamouroux) Decaisne within the taxonomic synonymy of *A. fragilis* has been accepted by later workers (Dawson 1954a; Papenfuss 1968; Silva et al. 1987). An additional species, *A. robusta*, was described by Itono (1979).

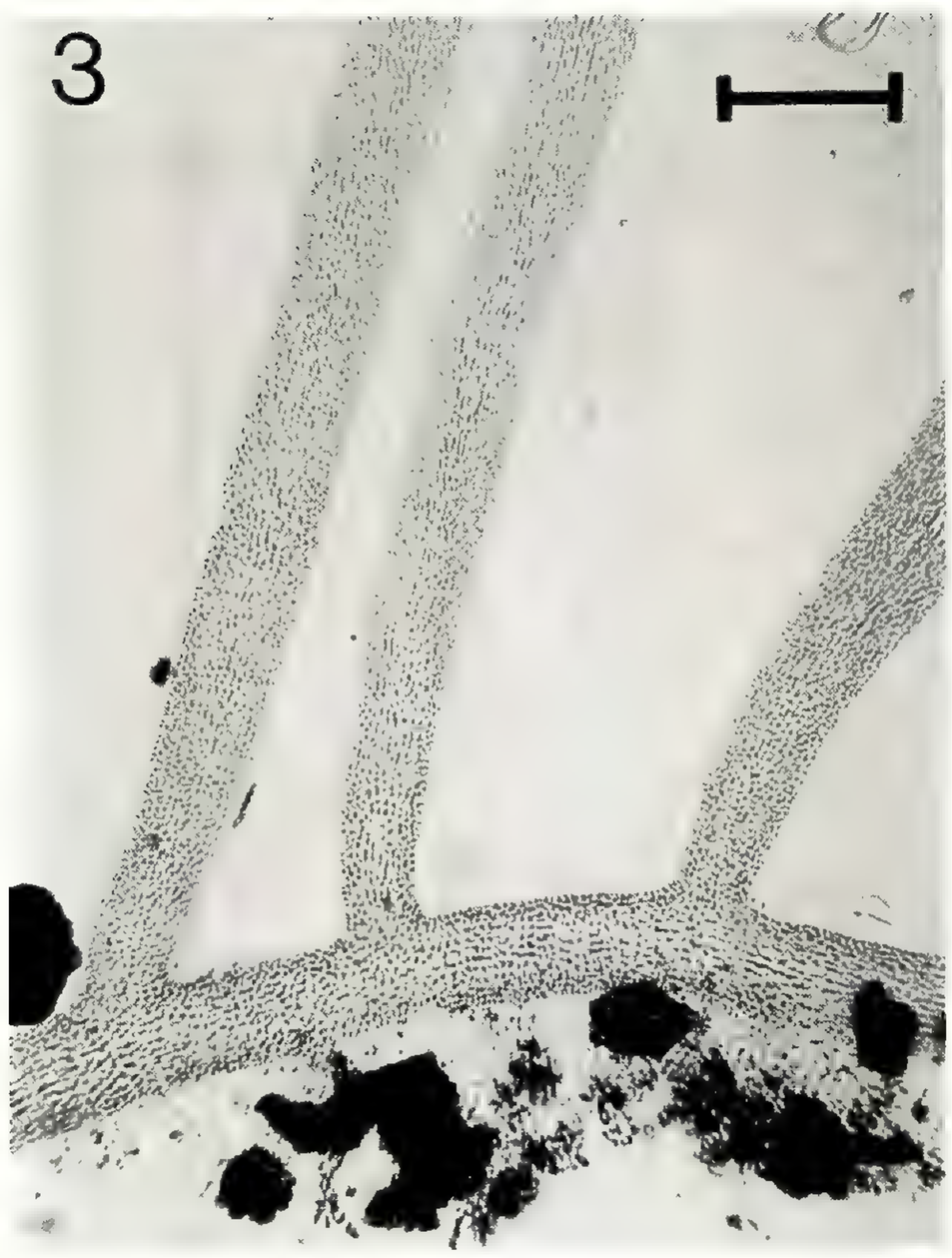
**Galaxaura rugosa** (Ellis & Solander) Lamouroux (1816).

Basionym: *Corallina rugosa* Ellis & Solander (1786).

Collection: 3T–2 (cystocarpic).

Previous Seychelles record: Kalugina-Gutknik et al. (1992).

Annulations characteristic of this species were present. The single cystocarpic specimen was devoid of assimilatory filaments, which are known to be usually absent in gametophytic plants but present in tetrasporophytes (Huisman & Borowitzka 1990). Papenfuss et al. (1982) indicated this species to be common in the western Indian Ocean. It was recorded as occurring at almost all the stations sampled in the Seychelles by Kalugina-Gutnik et al. (1992). Although Papenfuss et al. (1982) recognized *Galaxaura lapidescens* (Ellis & Solander) Lamouroux and *G. subverticillata* Kjellman as distinct from *G. rugosa*, Huisman and Borowitzka (1990) regarded these species as conspecific under *G. rugosa* on the basis that the presence of whorls or the even distribution of assimilatory filaments in the tetrasporophytes is a variable feature.



FIGS. 2–4. *Dermonema frappieri, Gelidiella pannosa,* and *Corynomorpha prismatica.* Fig. 2. *D. frappieri* (3B–2), herbarium specimen. Fig. 3. *G. pannosa* (3D–6), thallus of prostrate axis, attached by many rhizoids along its length, and erect axes. Fig. 4. *C. prismatica* (3D–6), transection of thallus with tetrasporangia. (Fig. 2, scale bar = 1 cm; Fig. 3, scale bar = 100 μm; Fig. 4, scale bar = 50 μm.)

## Gelidiales

### Gelidiaceae

***Pterocladia caespitosa** (Kylin) R. Norris (1987b). Fig. 5.

Basionym: *Gelidium caespitosum* Kylin (1938).

Collections: 3D–15 (tetrasporic); 3G–20; 3I–45 (tetrasporic); 3P–21 (male, cystocarpic, and tetrasporic).

The presence of cystocarpic thalli (Fig. 5a) with uniloculate cystocarps permits the identification of these collections as *Pterocladia*. The presence of rhizines in the medullary region rather than to the cortex is another feature used to distinguish *Pterocladia* from *Gelidium* (Taylor 1960). The most reasonable assignment is to *P. caespitosa*, a species first described from South Africa and later recorded from Mozambique (Isaac 1956) and Kenya (Isaac 1967). Norris (1987b) was the first to observe the unilocular cystocarps, allowing him to transfer the taxon to *Pterocladia*. In conformity with Norris's account of this alga, the Seychellois specimens have a stoloniferous prostrate system of terete axes giving rise periodically to erect blades (Fig. 5), which are often in tufts. The prostrate axes are firmly attached by peglike holdfasts to substrata, such as crustose coralline red algae. The erect blades usually are 4–6 mm tall but may reach 7–9 mm in height and are 1.0 mm in width. Apices of the erect blade are usually emarginate rather than gradually tapering like the apices of *P. caloglossoides* (Howe) Dawson (Howe 1914, pl. 35, figs. 9, 10; Renfrew et al. 1989). Additionally, in *P. caespitosa* the tetrasporangia initially may show a V-shaped arrangement, but this pattern rapidly becomes obscured; the mature sporangia are irregularly arranged in a central, elongate sorus on the erect blades or on lateral bladelets (Fig. 5b–d). In *P. caloglossoides*, which was reported from the Seychelles by Kalugina-Gutnik et al. (1992), the tetrasporangia retain their V-shaped arrangement (Santelices 1977; Renfrew et al. 1989).

### Gelidiellaceae

**Gelidiella acerosa** (Forsskål) Feldmann & Hamel (1934).

Basionym: *Fucus acerosus* Forsskål (1775).

Collections: 3D–5; 3P–6 (tetrasporic).

Previous Seychelles records: Untawale & Jagtap (1989); Kalugina-Gutnik et al. (1992).

Thalli have a very rigid texture and are pinnately branched to 1–2 orders. Axes are often arching and become secondarily attached along their lengths to the substratum or to other thalli. Erect portions are 2–3 cm tall, a value falling within the height range of 0.5–9.0 cm reported by Hatta and Prud'homme van Reine (1991). Cross-sections reveal the absence of medullary rhizines, a diagnostic feature of this genus. Tetrasporangia are borne in the swollen distal portions of the branches, as has been depicted by various authors (Kützing 1868, as *Echinocaulon spinellum* and *E. rigidum*; Weber-van Bosse 1928, as *Gelidiopsis rigida*; Trono & Ganzon-Fortes 1980). This species occurs commonly in most tropical seas.

**Gelidiella myriocladа** (Børgesen) Feldmann & Hamel (1934).

Basionym: *Echinocaulon myriocladum* Børgesen (1934).

Collection: 3S–42.

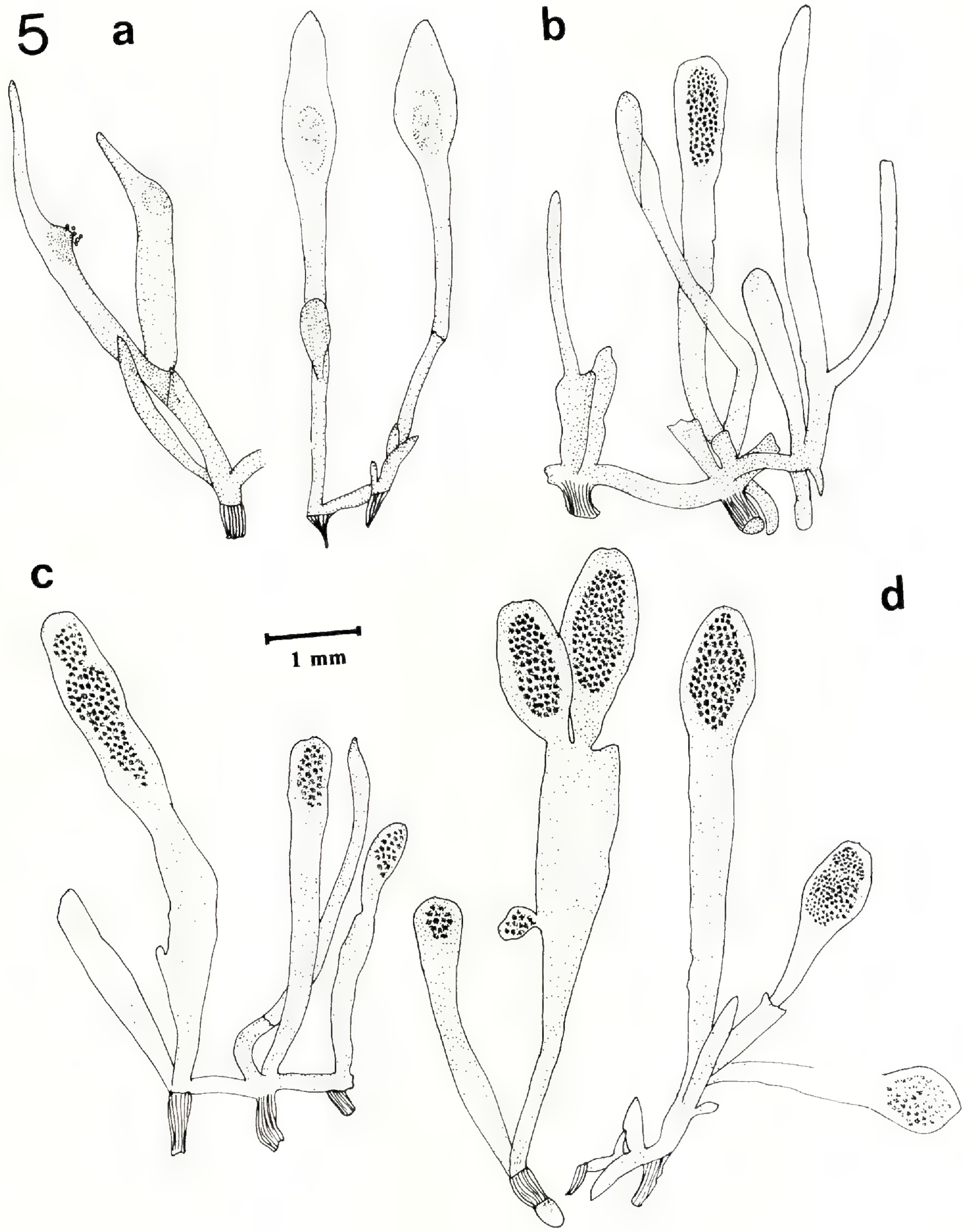



FIG. 5. *Pterocladia caespitosa* (3P–21). a, cystocarpic plants. b-d, tetrasporic plants.

Previous Seychelles record: Kalugina-Gutnik et al. (1992).

A creeping system of terete axes, epiphytic on a crustose coralline alga, gives rise to erect axes, which are 8–12 mm tall. The erect axes may be simple or pinnately branched, the pinnules often opposite and arising at right angles. This species was described by Børgesen (1934) as having surface cells ("roundish and about 5–6 μm broad") without any order but sometimes showing a tendency of being arranged in rows. Børgesen reported axes to be 60–160 μm wide. In their

study of Indonesian plants of this species Hatta and Prud'homme van Reine (1991) reported the diameter of prostrate axes to be 75–135 µm and that of erect axes to be 80–140 µm. Erect axes of the Seychellois plants measured 70–110 µm in breadth.

In their key to the 10 species of *Gelidiella* that were then recognized, Feldmann and Hamel (1934) separated *G. myrioclada* from *G. ramellosa* (Kützing) Feldmann & Hamel by the larger size of the cortical cells and their arrangement in more or less regular arrangement in longitudinal rows in the latter species. *Gelidiella myrioclada* differed from *G. nigrescens* (Feldmann) Feldmann & Hamel by the relatively broader axes of that species, namely, a breadth of 250–400 µm (Feldmann 1931b, as *Echinocaulon nigrescens*) and differed from *G. setacea* (Feldmann) Feldmann & Hamel by the greater height (2–3 cm) and greater breadth (150–200 µm) of that Antillean species (Feldmann, 1931b, as *Echinocaulon setaceum*).

**Gelidiella lubrica** (Kützing) Feldmann & Hamel (1936). Figs. 3, 6.

Basionym: *Acrocarpus lubricus* Kützing (1843).

Collections: 3D–6; 3S–29 (tetrasporic).

Previous Seychelles report: Kalugina-Gutnik et al. (1992).

Thalli of *Gelidiella lubrica* consist of a system of creeping axes (Fig. 3) growing tightly adherent to crustose coralline algae and giving rise to erect axes, which are simple or less often sparsely and irregularly branched. Erect axes have a diameter of 68–84 µm, are cartilaginous, and are cylindrical to somewhat compressed. Erect axes are 3–5 mm, a range that matches exactly that reported by Hatta and Prud'homme van Reine (1991) for Indonesian plants of this species. Cortical cells, which are angular in outline and about 4–6 µm in diameter, are vaguely arranged in longitudinal rows in younger parts of axes but are more haphazardly arranged in older axes. Terminal portions of mature, erect axes may bear numerous unicellular hairs, such as shown for this species by Feldmann and Hamel (1934, 1936). Prostrate axes are tightly attached to the substratum by peglike tufts of rhizoids. Tetrasporangia are borne in terminal, swollen portions of ordinary erect axes (Fig. 6).

The Seychellois material keys out to *Gelidiella lubrica* following the key of Hatta and Prud'homme van Reine (1991) to the four Indonesian species of this genus or the key of Norris (1992) to the three South African species of the genus. Although the former authors recognize *G. lubrica* and *G. pannosa* (Feldmann) Feldmann & Hamel as distinct species, Norris (1992) prefers to recognize the small species of *Gelidiella* (less than 20 mm) with peglike holdfasts and with more than four tetrasporangia in each stichidial segment under the name *G. lubrica*. According to Hatta and Prud'homme van Reine (1991), *G. lubrica* has more than two layers of inner cortical cells and medullary cells located in more than a single tier, whereas *G. pannosa* has 1–2 layers of inner cortical cells situated around one tier of medullary cells. Cross-sections of axes of the Seychellois material showed 3–4 layers of small cortical cells and a central region of larger medullary cells in more than a single tier.

Norris (1992) characterized *Gelidiella antipai* Celan (1938), another species of small stature (i.e., erect axes to 2 mm in height) as having its prostrate axes attached by rhizoids arising from most ventral cells and producing only four tetrasporangia in each fertile segment. Verlaque (1990), who added *G. antipai* to the flora of Corsica, regarded *G. stichidosporum* described by Dawson (1952) from Baja California, Mexico, as a taxonomic synonym, whereas Norris (1992) treated *G. adnata*, described by Dawson (1954a) from Vietnam, as conspecific with *G. antipai*.

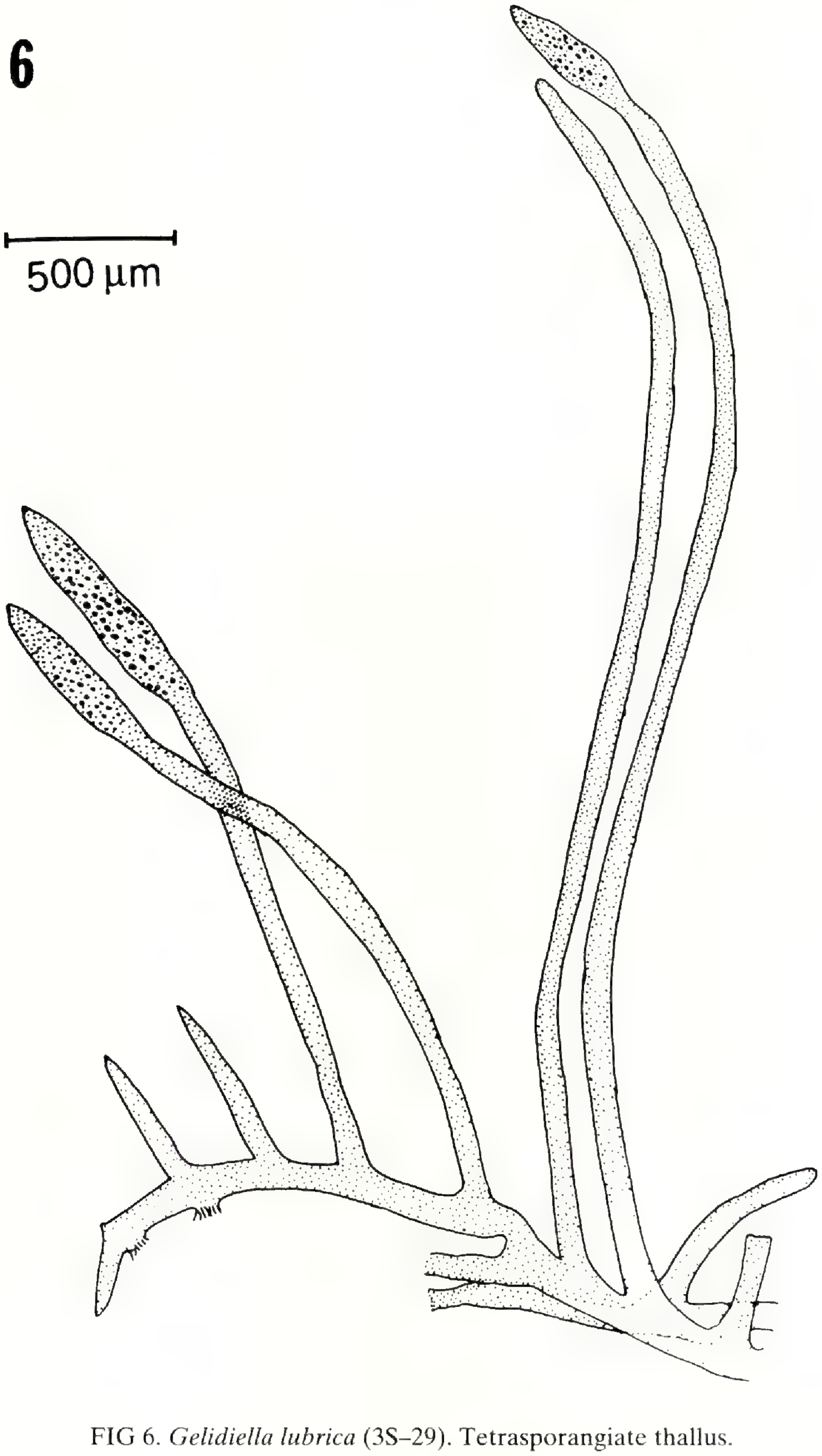



FIG 6. *Gelidiella lubrica* (3S–29). Tetrasporangiate thallus.

## CORALLINALES

### Corallinaceae

**Amphiroa foliacea** Lamouroux in Quoy et Gaimard (1824).
Collection: 3G–12.
Previous Seychelles report: Kalugina-Gutnik et al. (1992).

**Amphiroa fragilissima** (Linnaeus) Lamouroux (1816).
Basionym: *Corallina fragilissima* Linnaeus (1758).
Collection: 3U–1.
Previous Seychelles reports: Untawale and Jagtap (1989), Kalugina-Gutnik et al. (1992).

***Amphiroa tribulus** (Ellis & Solander) Lamouroux (1816).
Basionym: *Corallina tribulus* Ellis & Solander (1786).
Collection: 3D–2.

***Cheilosporum acutilobum** (Decaisne) Piccone (1886). Fig. 7.
Basionym: *Amphiroa* (*Cheilosporum*) *acutiloba* Decaisne (1842).
Collections: 3G–10; 3P–31.

This alga has a small stature (less than 1.5 cm tall), intergenicular segment lengths of 0.4–0.6 mm, and usually six tiers of medullary cells per intergenicular segment, features in agreement with Srimanobhas et al.'s (1990) account of this species. Although the marginal lobes of the intergenicular segments are usually simple and acute, they can also be incised. Johansen (1977) showed that in the South African *Cheilosporum cultratum* (Harvey) Areschoug the lobes can be usually simple and acute (subsp. *cultratum*) or they can be in part broad, flat, and incised (subsp. *multifidum*).

In a study of Japanese species of *Cheilosporum*, Srimanobhas et al. (1990) presented evidence that *C. jungermannioides* Ruprecht ex Areschoug in J. Agardh (1852) is a heterotypic synonym of *C. acutilobum*. The Seychellois specimens were growing entangled with *Caulerpa racemosa* (Forsskål) J. Agardh var. *peltata* (Lamouroux) Eubank and reach a few centimeters in overall extent. Srimanobhas et al. (1990) suggested that material from Mauritius depicted by Børgesen (1943, 1953, as *C. jungermannioides*) may actually belong to another species because of their relatively robust nature. It should be pointed out, however, that Mauritius is the type locality of *Cheilosporum acutilobum*. Kalugina-Gutnik et al. (1992) have reported the occurrence of *C. spectabile* Harvey ex Grunow from the Seychelles, a species with Tonga as its type locality (Grunow 1874); that species has a height of 7 cm or more (Srimanobhas et al. 1990).

**Jania adhaerens** Lamouroux (1816).
Collection: 3I–20.
Previous Seychelles reports: Untawale and Jagtap (1989), Kalugina-Gutnik et al. (1992).

The specimens, forming clumps of about 3 cm in height, occurred as epiphytes on *Sargassum*. Cribb (1983) proposed that *Jania capillacea* Harvey be placed in the taxonomic synonymy of *J. adhaerens*.

***Jania pumila** Lamouroux (1816).
Collection: 3E–8 (epiphytic on seagrass).
These thalli reach only 5–7 mm in height, and the axes are only up to about 90 µm broad.

**Jania ungulata** (Yendo) Yendo f. **brevior** (Yendo) Yendo (1905).
Basionym: *Corallina ungulata* Yendo f. *brevior* Yendo (1902).
Collection: 3S–39.

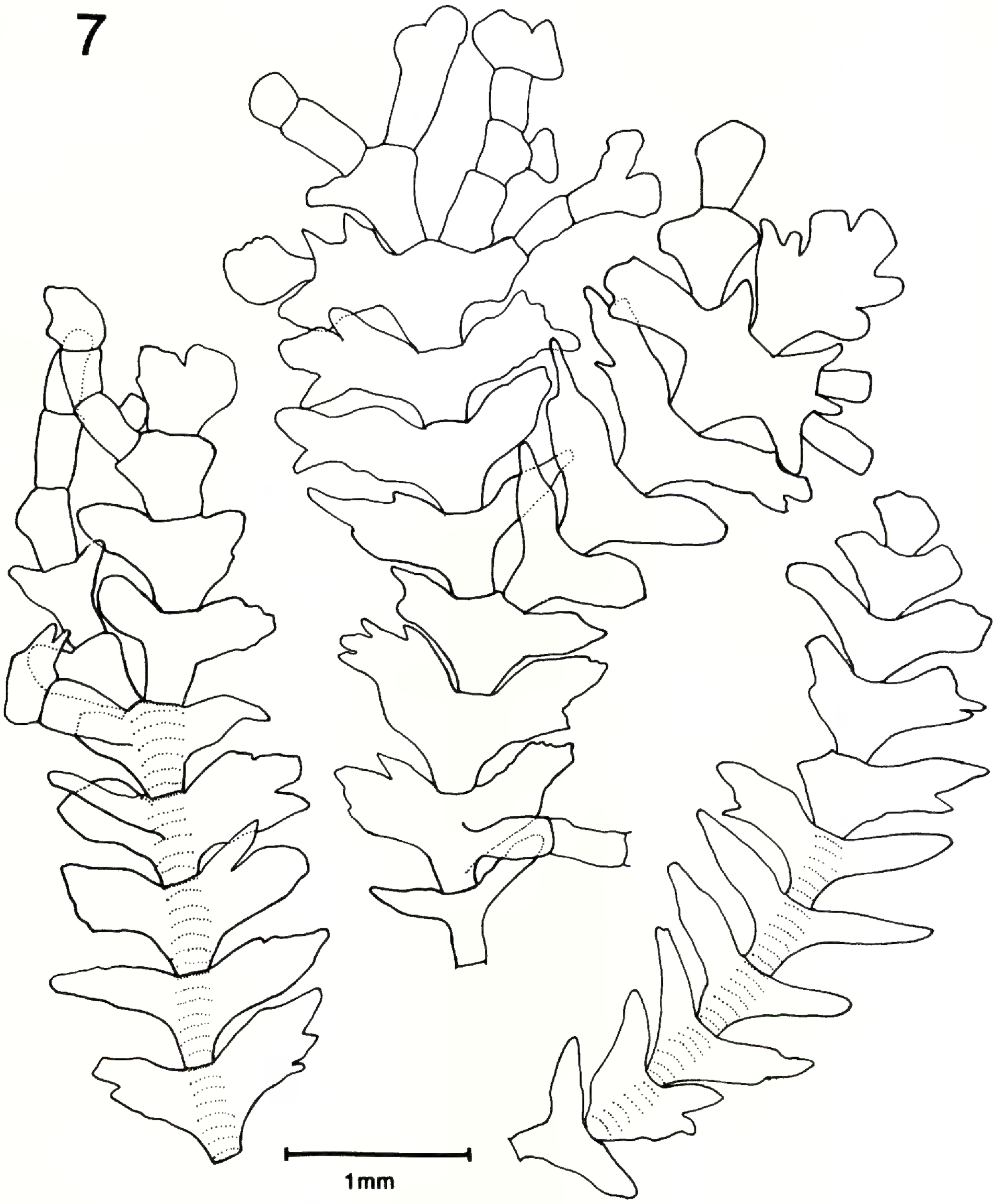



FIG. 7. *Cheilosporum acutilobum* (3P–31). Outlines of thalli.

Previous Seychelles report: Kalugina-Gutnik et al. (1992).

According to Jaasund (1976) this species is distinguished by its erect axes terminating in hoof-shaped segments.

## GIGARTINALES

### Corynomorphaceae

*__Corynomorpha prismatica__ (J. Agardh) J. Agardh (1872). Figs. 4, 8.

Basionym: *Dumontia prismatica* J. Agardh (1841).

Collections: 3I–25 (tetrasporic); 3P–2 (tetrasporic).

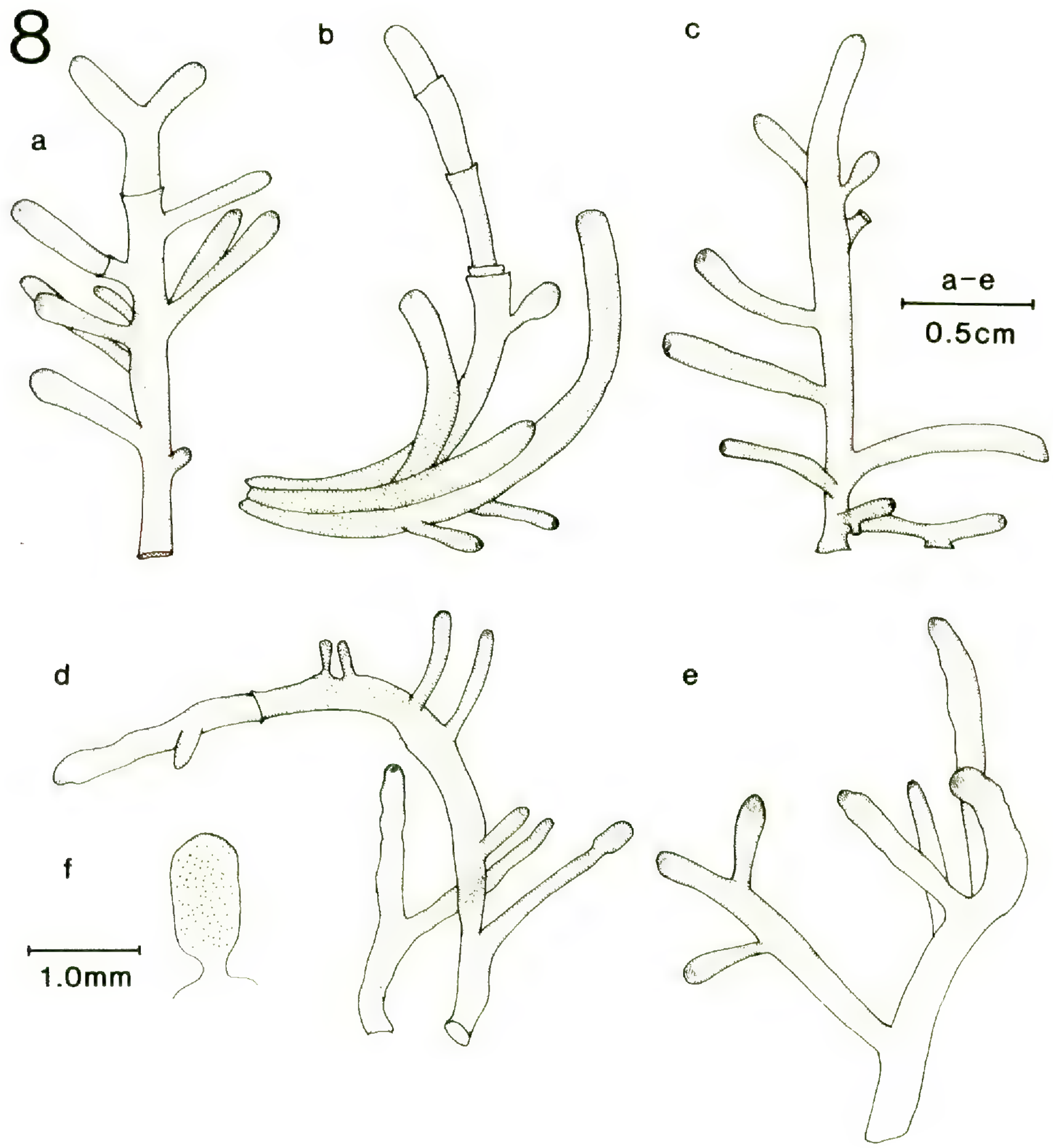



FIG. 8a–f. *Corynomorpha prismatica* (3I–25). Habit of thalli (a–e); axis bearing a terminal tetrasporangiate nemathecium (f).

The Seychellois plants of *Corynomorpha prismatica* reached only a few centimeters in height and were branched to only 1 or 2 orders, in contrast to a height of up to 15 cm and branching up to 5 orders reported by Desikachary et al. (1990) for Indian material of this species. Axes were often articulated (Fig. 8a–e); this effect most likely resulted from grazing of tips followed by regeneration. Tetrasporangia were borne in nemathecia (Fig. 4) located in swollen tips (Fig. 8f), which were borne on pedicels. The structure and reproduction of this species were described in some detail by Balakrishnan (1958, 1962). This species was characterized by Srinivasan (1960) as one of the rarer species of India. It is known from India (Desikachary et al. 1990), Sri Lanka (Børgesen 1937b), East Africa (Lawson 1980), and West Africa (Lawson & John 1987).

FIG. 9. *Hypnea cornuta* (3E–1). Portion of a thallus bearing stellate branches.

Halymeniaceae

*__Halymenia durvillaei__ Bory (1828). Fig. 10.

Collection: 3T–3.

Blades of this species were the largest and most showy of the red algae collected in the Seychelles. With Papua New Guinea as its type locality (Bory 1828), this species has a wide distribution in tropical Indo-Pacific seas (Weber-van Bosse 1921; Cribb 1983; Silva et al. 1987). A "*Halymenia* sp." was reported from the Seychelles by Kalugina-Gutnik et al. (1992).

Hypneaceae

**Hypnea cornuta** (Kützing) J. Agardh (1852). Figs. 9, 11.

Basionym: *Chondroclonium cornutum* Kützing (1849).

Collection: 3E–1 (epiphytic on seagrass).

Previous Seychelles reports: Mshigeni (1987a); Kalugina-Gutnik et al. (1992).

The presence of tri- and tetraradiate stellate branchlets (Fig. 6) is the primary criterion on which I assign this collection to *Hypnea cornuta*. The Seychellois plants (Fig. 11) form entangled tufts with no obvious percurrent axes, and axes become secondarily anchored to the seagrass host as well as to other axes. Tetrasporangia are borne in the mid-portions of short lateral branches that densely beset main axes.

The status of *Hypnea cornuta* has long been debated. Hauck (1887) treated *H. cornuta* within the synonymy of *H. valentiae* (Turner) Montagne, a position supported by Børgesen (1934, 1943) and Lawson and John (1987). However, other workers (e.g., Tanaka 1941; Taylor 1960; Pham-Hoàng 1969; Jaasund 1976; Silva et al. 1987; Yoshida et al. 1990; Shameel & Tanaka 1992) continue to recognize *H. cornuta*. In the opinion of Jaasund (1976) the stellate bulbils, which are easily detachable, seem to be "a reliable species character."

*__Hypnea nidifica__ J. Agardh (1852).

Collections: 3C–10 (cystocarpic); 3S–3.

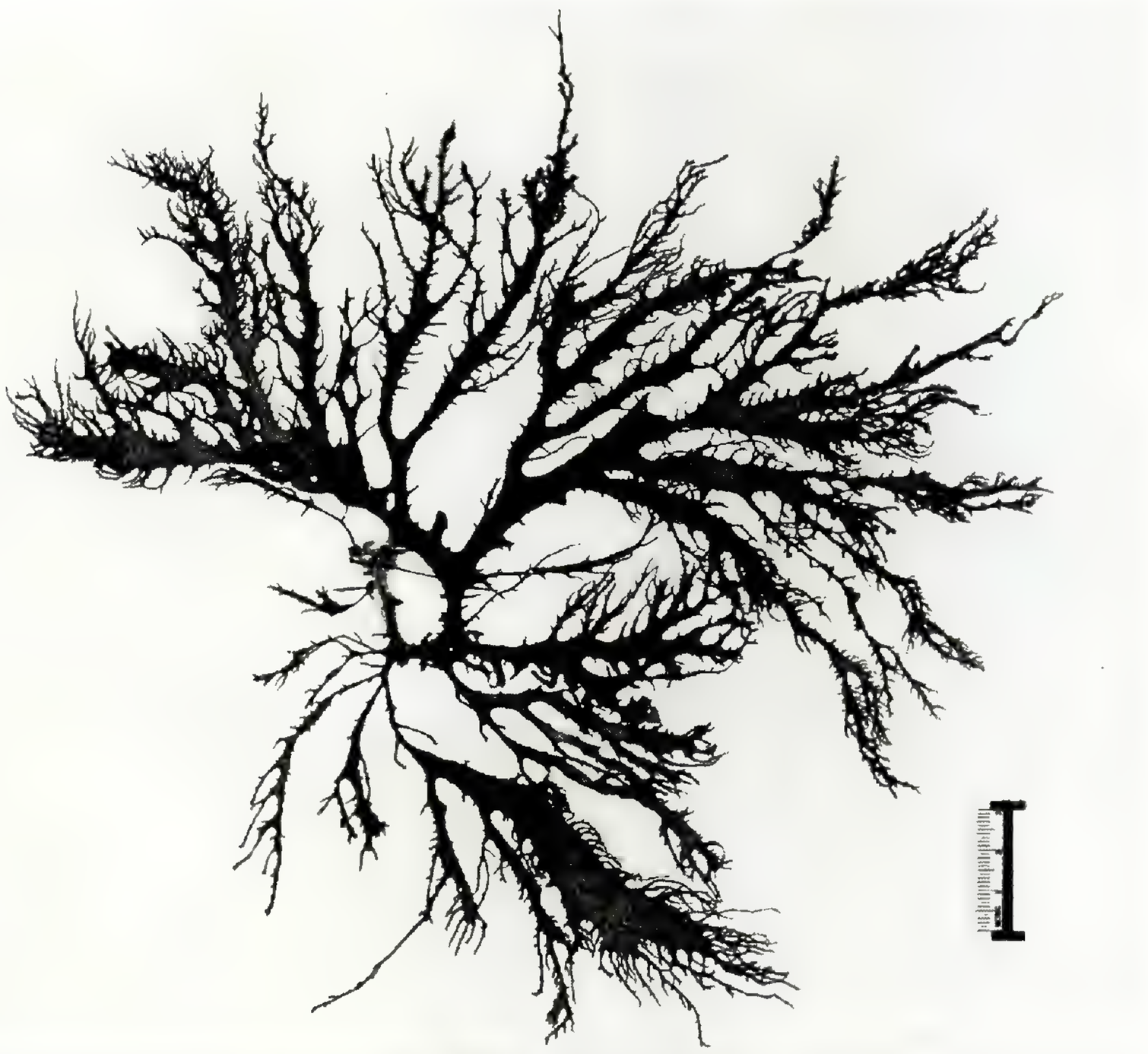
This alga has a sprawling habit, epiphytic on blades of a seagrass. Axes are terete (0.8–1.2 mm in diameter) and irregularly alternately branched, with many spinose branches. Secondary attachments are commonly formed both from apices and laterally.

Originally described from Hawaii (J. Agardh 1852), this species has also been recorded from Tahiti (Setchell 1926), Indonesia (Weber-van Bosse 1928), the Gulf of California (Dawson 1944), and Tanzania (Jaasund 1976). In agreement with Jaasund's (1976) account of this species, branching is loose and divaricate, branchlets are re-branched, and a percurrent main axis is absent. There is some discrepancy between the sprawling, secondarily attached habit of the Seychellois *H. nidifica* with Mshigeni's (1978) account of this species in Hawaii in that he described it as growing much taller and more entangled than all the other Hawaiian species of *Hypnea*.

**Hypnea pannosa** J. Agardh (1847).

Collections: 3P–38; 3T–4.

Previous Seychelles reports: Mshigeni (1987a), Kalugina-Gutnik et al. (1992).



FIGS. 10–12. *Halymenia durvillaei, Hypnea cornuta,* and *Hypnea spinella.* Fig. 10. *H. durvillaei* (3T–3), herbarium specimen. Fig. 11. *H. cornuta* (3E–1), thallus epiphytic on seagrass. Fig. 12. *H. spinella* (3S–27), enlarged branchlets bearing tetrasporangia. (Fig. 10, scale bar = 3 cm; Fig. 11, scale bar = 2 cm; Fig. 12, scale bar = 100 μm.)

Compactly intricate cushionlike mats characterize *Hypnea pannosa*. Living thalli exhibit a blue-green iridescence. Axes are compressed, and apices are divaricate or obliquely truncate (Tanaka & Pham-Hoàng 1962). Tetrasporangial sori are formed as a swelling on only one side of a branch in its mid-region. This species is known to have a pantropical distribution (Weber-van Bosse 1928; Tanaka 1941; Børgesen 1943; Taylor 1960; Jaasund 1976; Mshigeni 1978; Trono & Ganzon-Fortes 1980; Cribb 1983).

*__Hypnea saidana__ Holmes (1896). Fig. 16.

Collections: 3G–11; 3I–43.

This alga formed abundant, large clumps of interlocking, brittle complanate axes around the non-living bases of staghorn corals. The color of the alga was bright blood-red. Cribb (1983) suggested that *Hypnea saidana* may prove to be a synonym for *H. pannosa*; however, several differences serve to distinguish this pair of species. Thalli of *H. pannosa* consist of axes only about 1 mm thick and form small compact tufts or a turf on rocks. The height of the axes is 1 to a few centimeters, and the organization is very tight and compact. Thalli of *H. saidana* have somewhat broader axes (to 2 mm) and also form an intricate-caespitose clump but of a much looser organization. The height of the clump of *H. saidana* is 5–10 cm. J. Agardh (1852) placed *H. saidana* in his Section *Spinuligerae* of the genus and *H. pannosa* in Section *Pulvinatae*, and this placement was followed by Tanaka (1941).

**Hypnea spinella** (C. Agardh) Kützing (1847). Fig. 12.

Basionym: *Sphaerococcus spinellus* C. Agardh (1822).

Collections: 3G–18; 3I–16 (tetrasporic and cystocarpic); 3S–27 (tetrasporic).

Previous Seychelles reports: Mshigeni (1987a, as *H. cervicornis*), Untawale and Jagtap (1989, as *H. cervicornis*), Kalugina-Gutnik et al. (1992, as *H. cervicornis* and *H. spinella*).

This alga has a loosely intricate-caespitose habit and was growing attached at many points by haptera to various substrata, including crustose coralline algae and rock. It was associated with *Pterocladia caespitosa* and *Laurencia* spp. Main axes in the Seychellois plants were 360–600 µm in diameter; this range compares with that of 200–500 µm given by Cribb (1983) and 236–600 µm given by Egerod (1971, as *H. esperi*). Ultimate branches, which tend to be short and acute, are converted into tetrasporangial stichidia and become enlarged relative to vegetative branches. Lenticular thickenings in the walls of medullary cells were prominent in collection 3S–27.

There has been some debate whether to retain *Hypnea spinella* and *H. cervicornis* as distinct species or to regard them as conspecific. Some authors (Mshigeni 1978; Lawson & John 1987; Price & Scott 1993) continue to separate these two species on the basis that in *H. spinella* the final branchlets are acute and needle-like, up to 4 mm long, and the axes are more prostrate and anastomosing, whereas in *H. cervicornis* the final branchlets are shorter (to 1.5 mm long) and broader and the axes are more erect, entangled but not becoming mutually attached. Mshigeni (1978) described the tetrasporangial stichidia of *H. spinella* as ophiocephalous (i.e., with the sorus localized at the apex) or having the swelling in the middle portion compared with the stichidia of *H. cervicornis* as sometimes being branched and having the tetrasporangial swellings often at the bases of the stichidia. Although recognizing both species, Børgesen (1920) suspected that *H. spinella* is a form

occurring in more exposed sites and *H. cervicornis* is a form occurring in more protected sites. Børgesen's intuition has been recently supported by observations made in the Canary Islands by Haroun & Prud'homme van Reine (1993), who concluded that these taxa are ecologically induced growth forms of the same species. *Hypnea spinella* is the intertidal form, and *H. cervicornis* merely represents the subtidal form. Indeed, earlier Tanaka (1941), Tanaka and Pham-Hoàng (1962), and Cordero (1977) also regarded these two taxa as conspecific, but they adopted *H. cervicornis*, the more recent name.

The present treatment accepts the opinion of Mshigeni (1978) and Price and Scott (1993) in regarding many reports (e.g., Børgesen 1924; Tanaka 1941; Dawson 1954a, 1957; Egerod 1971) of *Hypnea esperi* Bory (1828) as assignable to *H. spinella*. According to Dawson (1961), Kützing's (1868) figure of *H. esperi* conforms to *H. cervicornis* J. Agardh (1852) [=*H. spinella*], whereas authentic *H. esperi* nom. illegit. (see Silva et al., 1987) is best relegated to taxonomic synonymy within *H. musciformis* (Wulfen) Lamouroux, as first proposed by J. Agardh (1852).

**Hypnea valentiae** (Turner) Montagne (1841).

Basionym: *Fucus valentiae* Turner (1809).

Collection: 3K–6 (tetrasporic).

Previous Seychelles reports: Mshigeni (1987a), Kalugina-Gutnik et al. (1992).

Thalli of this species are erect and laxly branched, with distinct or percurrent cylindrical main axes (Trono & Ganzon-Fortes 1980). Although some authors (e.g., Tanaka 1941; Jaasund 1976; Cordero 1977; Lawson 1980) have recognized *Hypnea hamulosa* (Turner) Montagne, Papenfuss (1958) pointed out that Turner's (1809) *Fucus hamulosus* was not described as new by him but credited to *F. hamulosus* Esper (1800). J. Agardh (1852) referred Esper's plant to *Hypnea nigrescens* Greville ex J. Agardh with a query, whereas Turner's plant has been referred to *H. valentiae* by various authors (Kützing 1849; Hauck 1887; Børgesen 1943).

## Rhabdoniaceae

*__Caulacanthus ustulatus__ (Turner) Kützing (1843). Figs. 13–15.

Basionym: *Fucus acicularis* Wulfen [var.] *ustulatus* Turner (1809).

Collections: 3C–11; 3S–43 (tetrasporic; epiphytic on *Laurencia articulata*).

Thalli consist of an intricate system of cylindrical axes forming a prostrate or decumbent mat attached to the substratum and to self (Figs. 13a, 15). Each axis or branch terminates in a single apical cell, which undergoes oblique divisions (Feldmann & Hamel 1934). Transections of axes (Fig. 13c) show a prominent thick-walled axial filament, surrounded by loosely organized, round medullary cells and a single cortical cell layer, in agreement with the account by Searles (1968). Holdfasts are produced in abundance, often in close proximity to an apex (Fig. 13d). The holdfasts are multicellular, consisting of rhizoidal outgrowths of the cortical cells. Axes are terete and measure 110–120 μm in diameter, a value slightly less than that reported by West and Calumpong (1990) for an Australian isolate of this species. Branches arise alternately and irregularly from all sides. Tetrasporangia are produced in ordinary axes or branches, causing no unusual enlargment or swelling of the fertile axis (Figs. 13b, 14). Tetrasporangia are zonately divided (Fig. 13b) and measure 40–46 μm in length by 20–24 μm in diameter. Sexual thalli were not observed.

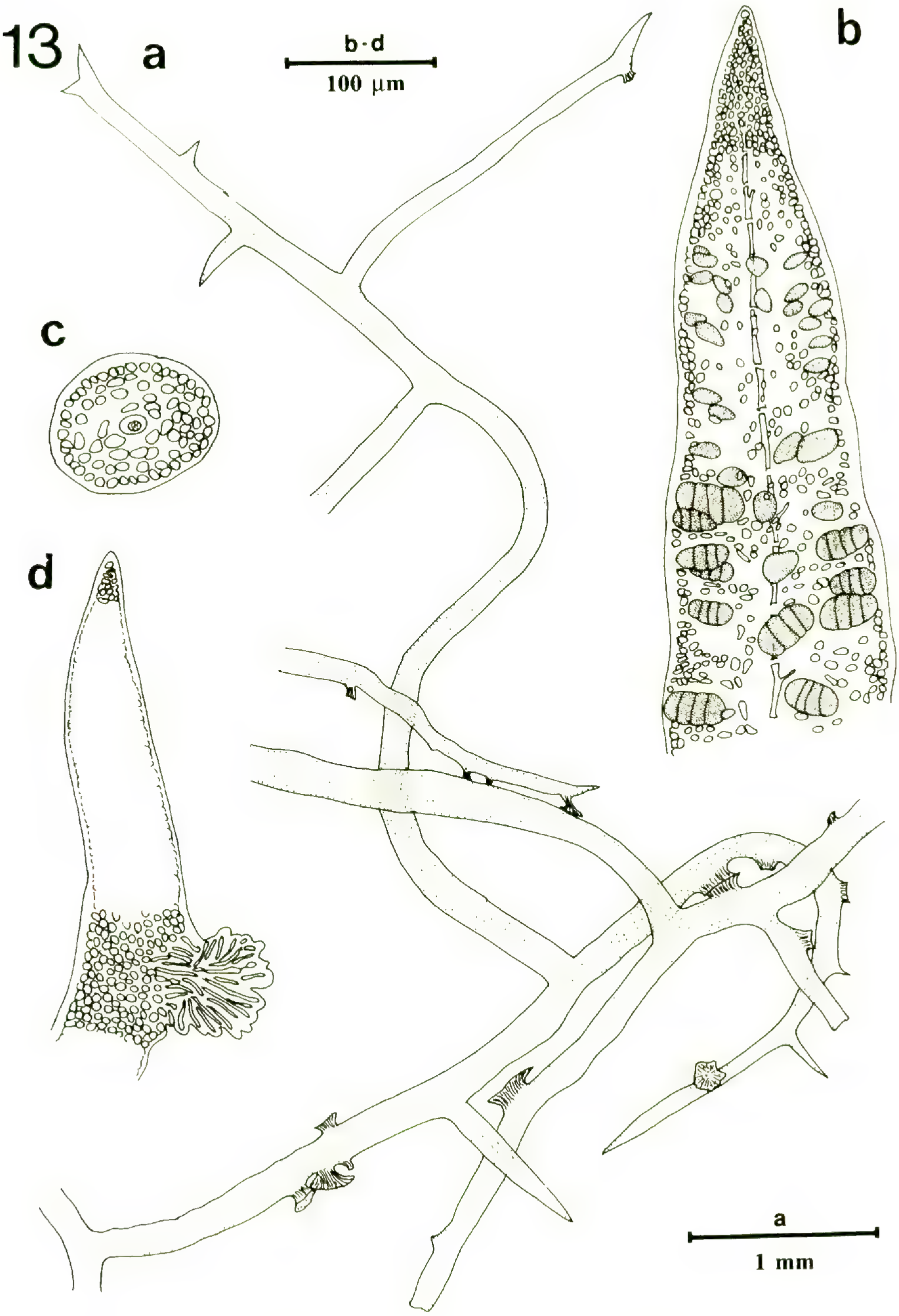
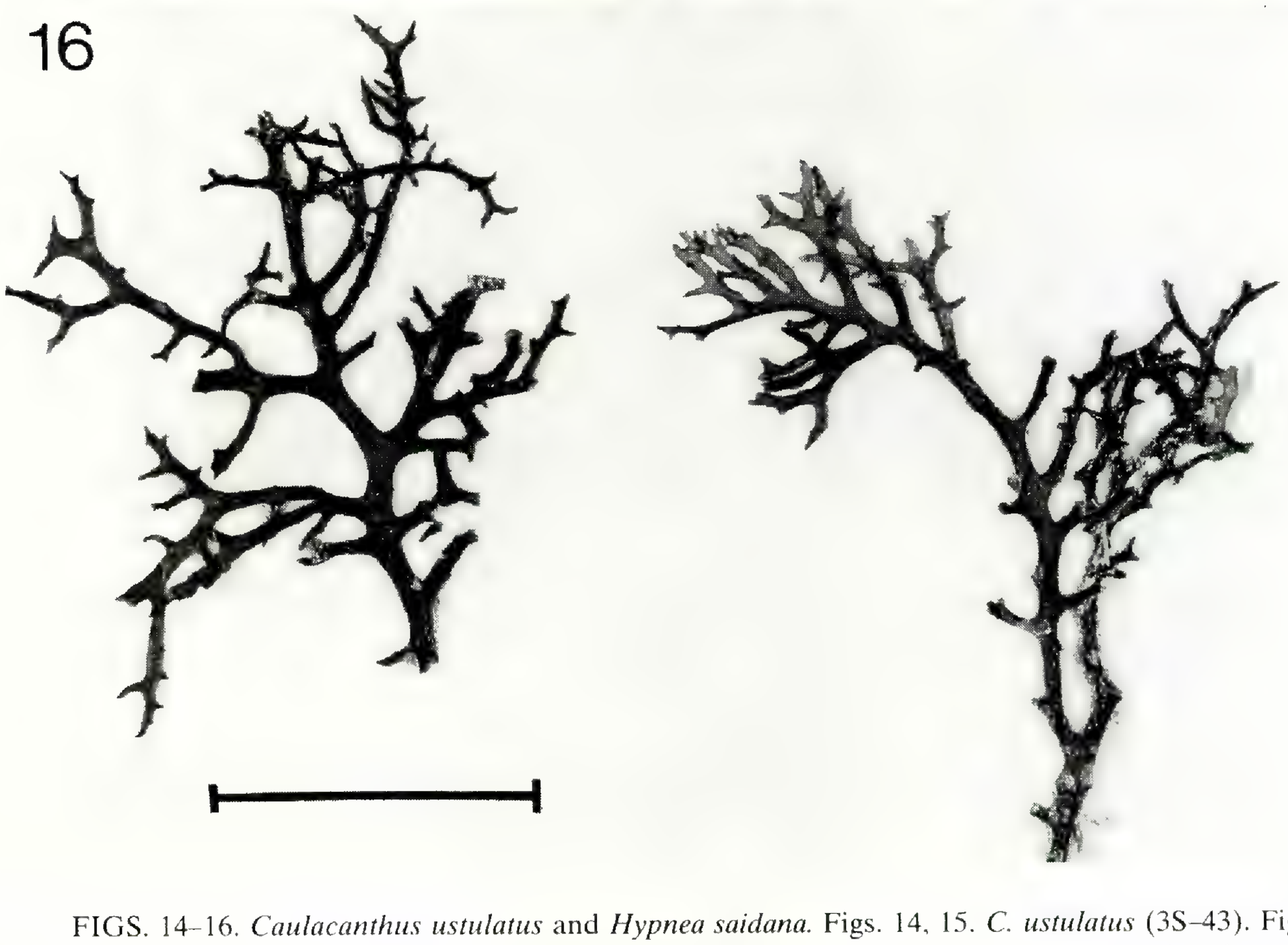



FIG. 13. *Caulacanthus ustulatus* (3S–43). a, habit. b, tetrasporangiate branch. c, transection of axis. d, production of holdfast near an apex of axis.




FIGS. 14–16. *Caulacanthus ustulatus* and *Hypnea saidana.* Figs. 14, 15. *C. ustulatus* (3S–43). Fig. 14, tetrasporangia (*arrows*) produced in non-modified branches. Fig. 15, prostrate axes bearing attachment pads (*arrows*). Fig. 16. *H. saidana* (3G–11), herbarium specimens. (Fig. 14, 15, scale bar = 100 μm; Fig. 16, scale bar = 2 cm.)

West and Calumpong (1990) proposed that *Caulacanthus indicus* Weber-van Bosse (1921) and *C. okamurai* Yamada (1933) be regarded as conspecific with *C. ustulatus*. Their evidence was based on the variability of the characters traditionally used to differentiate these three taxa, and their case was reinforced by the ability of two isolates (a Philippine isolate identified as *C. usutulatus* and an Australian identified as *C. indicus*) to interbreed. A "*Caulacanthus* sp." was reported from the Seychelles by Kalugina-Gutnik et al. (1992).

## Gracilariales

### Gracilariaceae

**Gracilaria canaliculata** Sonder (1871). Fig. 17.

Collection: 3L–1.

Previous Seychelles reports (all as *G. crassa*): Mshigeni (1987a), Untawale and Jagtap (1989), Kalugina-Gutnik et al. (1992).

This alga consists of tough, non-constricted axes intertwined into clumps reaching 30 cm in overall extent. Individual axes are terete and 2.5–3.0 mm in diameter. Branching is mostly dichotomous but also alternate and irregular. There are 4 to 5 orders of branches. The medullary cells usually exceeded 200 μm in diameter, a feature separating this species from *Gracilaria fergusonii* J. Agardh. This treatment follows Newton's (1953) placement of *G. crassa* Harvey ex J. Agardh (J. Agardh 1876) and *Corallopsis opuntia* J. Agardh (J. Agardh 1876) as taxonomic synonyms of *G. canaliculata*, but it does not agree with Xia's (1986) merger of *G. canaliculata* into *G. salicornia*.

In their recent analysis of *Gracilaria* in Australia, Withell et al. (1994) present a somewhat equivocal treatment of *G. canaliculata* in that they provisionally accept Xia's judgment (1986) to merge it with *G. salicornia,* while at the same time they assert that the reasons for this merger are not evident on the basis of the Australian specimens. Thus, they also recognize a "*Gracilaria canaliculata* Sonder form of *Gracilaria salicornia*" as occurring in northern and western Australia as well as New Caledonia, Sri Lanka, and India. In their key to species, Withell et al. (1994) characterize *G. salicornia* as having plants with slightly to highly constricted branch bases and few to many intercalary branch constrictions, whereas they characterize the "*G. canaliculata* form" as having plants with or without slight constrictions at the bases of the branches and lacking intercalary branch constrictions. They also note a difference in the nature of the cystocarps, which are more protruberant and constricted at the base in *G. salicornia* than in the "*G. canaliculata* form" and also lack the hyaline ring of surrounding tissue that is a feature of their "*G. canaliculata* form." They conclude by stating that male plants of *G. canaliculata* from New Caledonia, the type locality, need to be verified before attempting to relegate *G. canaliculata* to synonymy. My own observations on the Seychellois material strongly suggest that two species can be recognized; plants of *G. canaliculata* have non-constricted or barely constricted axes, and plants of *G. salicornia* have strongly and regularly constricted axes.

Silva et al. (1987) listed both *Gracilaria canaliculata* and *G. salicornia,* and pointed out that *Sphaerococcus canaliculatus* Kützing (1868), the intended basionym of *G. canaliculata*, is a later homonym and thus illegitimate. Article 72.1 of the ICBN permits treating *Gracilaria canaliculata* Sonder as a *nomen novum.*

FIGS. 17, 18. *Gracilaria canaliculata* and *G. salicornia*. Fig. 17. *G. canaliculata* (3L–1), herbarium specimen. Fig. 18. *G. salicornia* (3C–9), herbarium specimen. (Scale bars = 2 cm.)

**Gracilaria salicornia** (C. Agardh) Dawson (1954c). Fig. 18.

Basionym: *Fucus salicornia* C. Agardh (1820).

Collections: 3C–9; 3S–1.

Previous Seychelles report: Untawale and Jagtap (1989).

Regularly constricted axes characterize *Gracilaria salicornia* (Fig. 18). Percurrent axes are not evident. Plants occurred commonly in the mid-littoral zone and showed a tendency to bind the sandy substratum.

According to Trono and Ganzon-Fortes (1980) two growth forms of this species, correlated with degree of exposure and water conditions, are observable in the Philippines. Laxly branched, decumbent plants, which are bright orange and with dichotomous to tetrachotomous branching, are favored in well-protected areas where the substratum is sandy to sandy-rocky and the water is turbid. Prostrate, clump-forming plants, which are dark-green to brown and with irregular to subdichotomous branching, are favored in partially exposed areas where the water is clear.

## RHODYMENIALES

### Rhodymeniaceae

**Botryocladia skottsbergii** (Børgesen) Levring (1941).

Basionym: *Chrysymenia skottsbergii* Børgesen (1924).

Collection: 3P–1.

Previous Seychelles report: Kalugina-Gutnik et al. (1992).

This alga was noted to be found at almost all stations by Kalugina-Gutnik et al. (1992). It has been reported from scattered sites in tropical seas, including Easter Island, the type locality (Børgesen 1924, as *Chrysymenia skottsbergii*), Indonesia (Weber-van Bosse 1928, as *Botryocladia kuckuckii*), southern Japan (Yamada & Tanaka 1938, as *Chrysymenia kuckuckii*), Tanzania (Jaasund 1976), southern China (Zhang Junfu & Xia Bangmei 1978), Hawaii (Magruder & Hunt 1979), and Lord Howe Island, Australia (Millar 1990).

*__Gelidiopsis repens__ (Kützing) Weber-van Bosse (1928). Fig. 19.

Basionym: *Gelidium repens* Kützing (1868).

Collections: 3I–1; 3J–6; 3N–4; 3P–6 (tetrasporic).

This species was commonly encountered growing on crustose coralline algae and on corals. The alga formed a rhizomatous system of cylindrical axes giving rise to erect thalli, which usually were in the form of deeply divided palmate blades (Fig. 19). The erect blades were about 0.8–2.0 (rarely to 4) cm tall. Setchell (1926, as *Gelidium acrocarpum*) depicted this taxon from Tahiti.

Børgesen (1952, figs. 13, 14) figured an alga from Mauritius, at first identifying it as *Gelidiopsis scoparia* (Montagne & Millardet) Schmitz, but subsequently Børgesen (1957, pg. 28 footnote) changed his identification to *Gelidiopsis acrocarpa* (Harvey) Schmitz. Norris (1987c) regarded *G. acrocarpa* to be a later taxonomic synonym of *Gelidiopsis repens*, an opinion which is accepted here. These thalli usually have a well-developed prostrate system giving rise to erect, cylindrical branched axes. The erect portions may form palmately divided flat branches.

Price and Kraft (1991) presented arguments that *Gelidiopsis* and *Ceratodictyon* should be maintained as distinct genera contrary to the viewpoint expressed by Norris (1987c). In addition, on the basis of procarp structure, early gonimoblast and fusion cell development, mature cystocarp structure, and the cruciately divided tetrasporangia, Price and Kraft (1991) assigned these two genera to the Rhodymeniaceae rather than to the Gracilariaceae or the Gigartinales, in which groups they had formerly been placed.

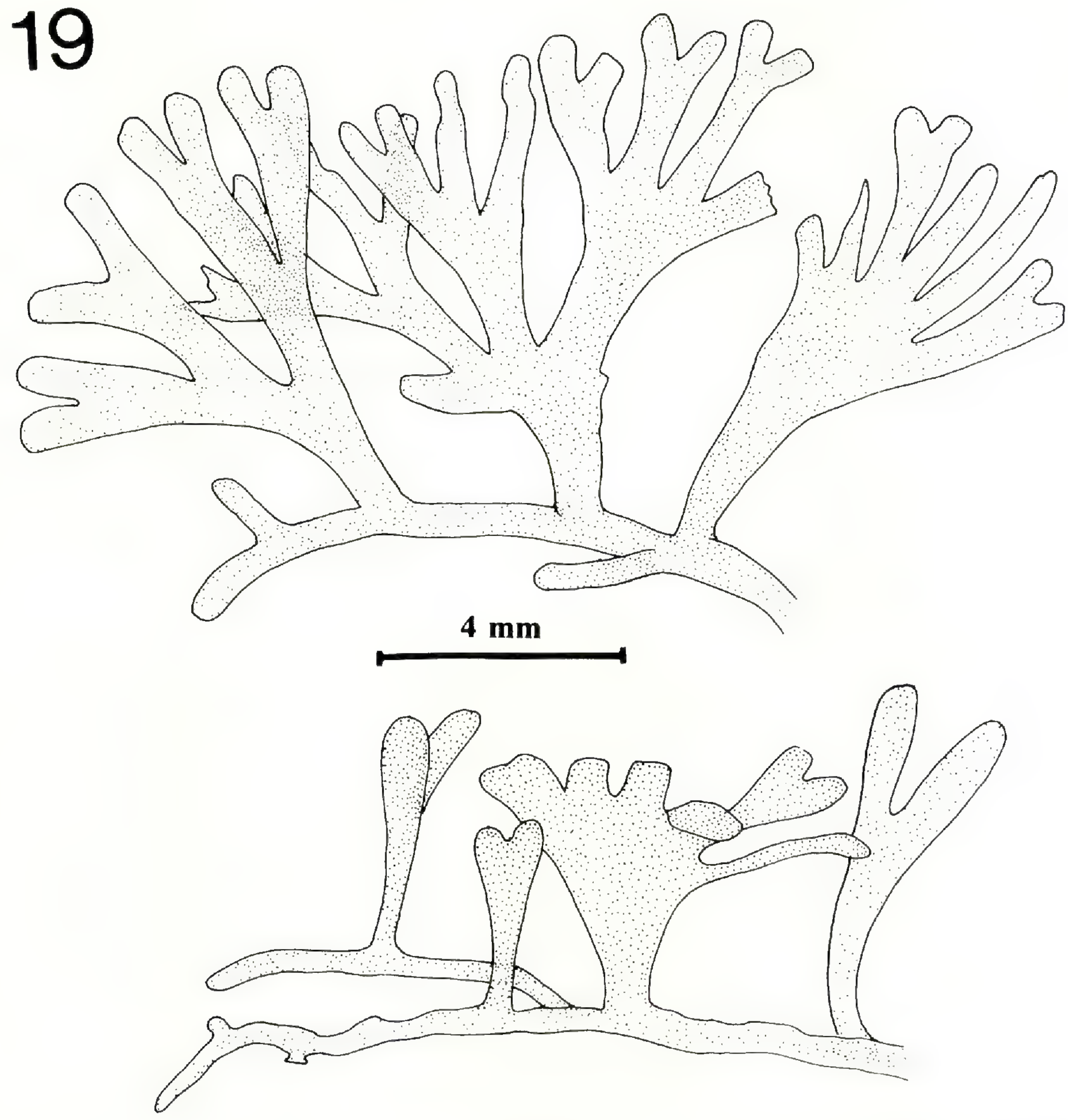



FIG. 19. *Gelidiopsis repens* (3J–6). Thalli of erect palmate blades arising from prostrate cylindrical axes.

## Champiaceae

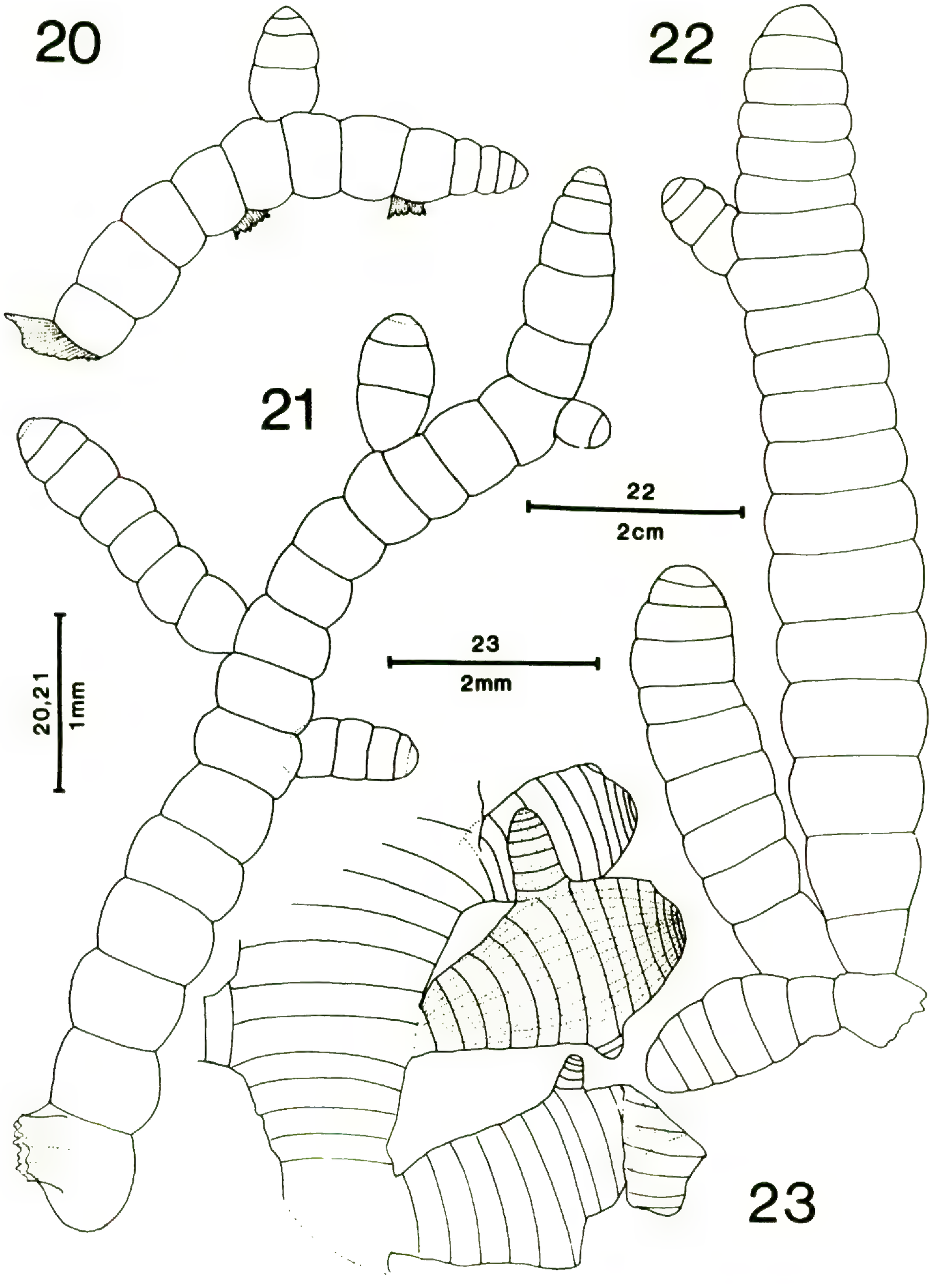
**Champia parvula** (C. Agardh) Harvey (1853). Figs. 20, 21.

Basionym: *Chondria parvula* C. Agardh (1824).

Collections: 3C–21; 3S–40 (epiphytic on *Dictyosphaeria versluysii*).

Previous Seychelles reports: Mshigeni (1987a), Kalugina-Gutnik et al. (1992).

The plants of *Champia parvula* tended to be sprawling, with a number of holdfasts being developed at multiple sites, resulting in the axes becoming interconnected with a strongly adherent habit. This caespitose habit in which the axes become intergrown was described by Dawson (1944) for *C. caespitosa*, which allegedly differed from *C. parvula* by its abundant production of holdfasts and its compact, caespitose habit, but later Dawson (1963) expressed the opinion that *C. caespitosa* was not distinct from *C. parvula*.




FIGS. 20–23. *Champia parvula* and *C. viellardii*. Figs. 20, 21. *C. parvula* (3S–40), thalli with cylindrical axes. Figs. 22, 23. *C. viellardii*, thalli with flattened axes. Fig. 22, young thallus (3S–24). Fig. 23, portion of mature thallus (3P–17.)

Cremades (in Cremades & Pérez-Cirera 1990) proposed to replace the familiar name *Champia parvula* with *Champia intricata*, a new name based on *Conferva intricata* Clemente (1807), which predates *Chondria parvula* C. Agardh (1824). Interestingly, both of these taxa have the same type locality, viz., Cadiz, Spain. Silva (1992), however, pointed out that Clemente's *C. intricata* is a later homonym and thus illegitimate.

**Champia vieillardii** Kützing (1866). Figs. 22–24.

Collection: 3P–17 (male); 3S–24.

Previous Seychelles report: Kalugina-Gutnik et al. (1992).

The specimens are fragmentary (Fig. 23), but the strongly flattened axes, measuring 2–3 mm in width, showed this alga to belong to *Champia vieillardii*. The barrel-shaped segments were much broader than long (Figs. 22, 24), which is also characteristic of this species. Some disagreement exists on whether *Champia compressa* Harvey is distinct or not from *C. vieillardii*. Following the proposal of Grunow (1874), Silva et al. (1987) regarded these taxa as conspecific. Earlier, Dawson (1954a) discussed reasons for maintaining them as distinct species. Millar (1990) presented several criteria by which *C. vieillardii* can be separated from *C. compressa*. I concur with his opinion and assign the Seychellois collection to *C. vieillardii* on the basis of the extremely flattened nature of the axes, the negligible constrictions associated with the diaphragms, and its more recumbent nature. The axes of *C. compressa* are compressed rather than flattened, definite constrictions are associated with the diaphragms, and the thalli are not firmly attached to the subtratum.

In addition to these two species of *Champia*, Kalugina-Gutnik et al. (1992) also reported *C. globulifera* Børgesen, *C. indica* Børgesen, and *C. salicornoides* Harvey from the Seychelles.

**Lomentaria corallicola** Børgesen (1939).

Collections: 3P–15 (tetrasporic); 3G–19 (cystocarpic).

Previous Seychelles report: Kalugina-Gutnik et al. (1992).

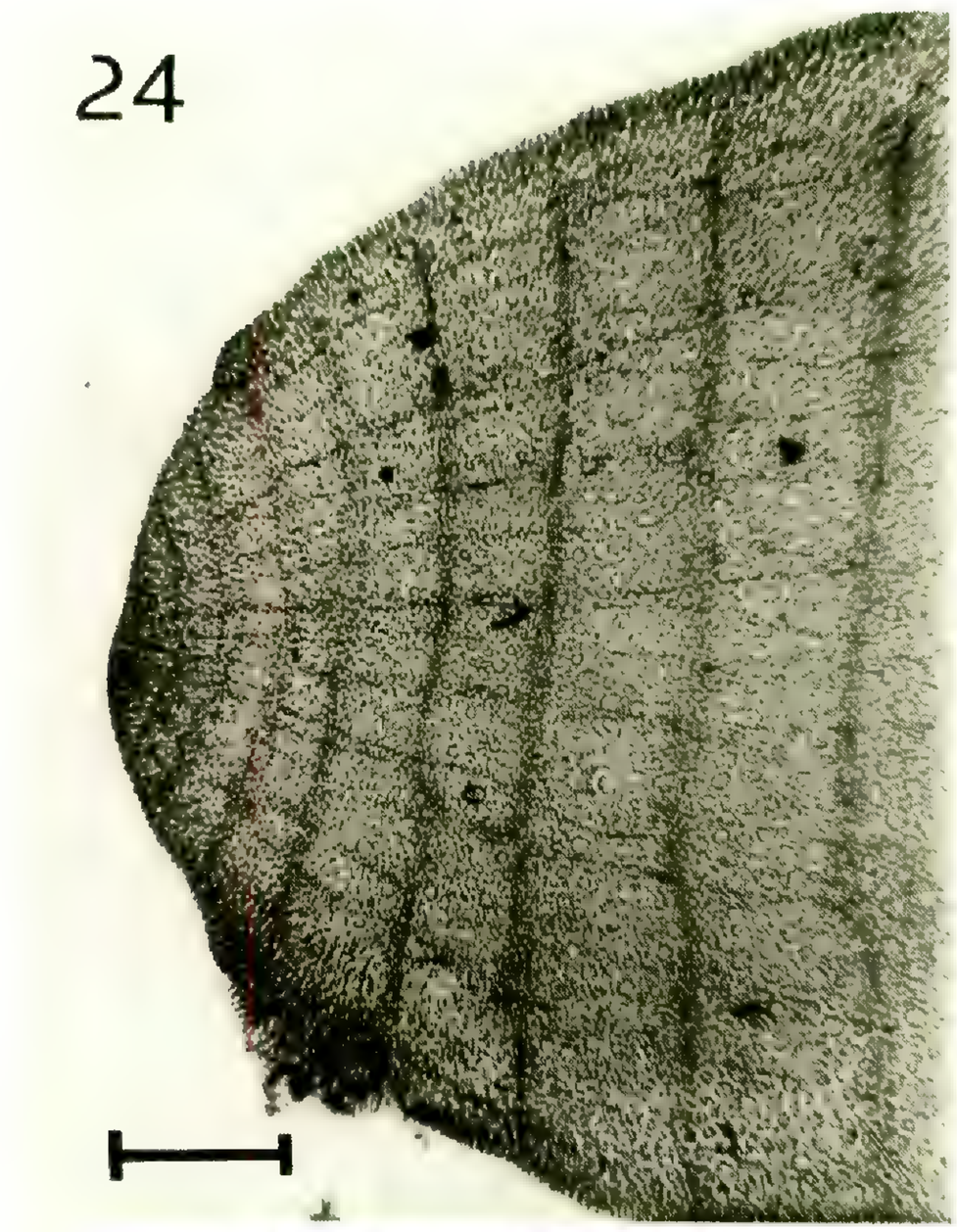
The axes in this alga become mutually connate by tufts of rhizoids developed from the cortex. Axes in this species reach 750 µm in diameter. Børgesen (1939, 1944) described *Lomentaria corallicola* from the Iranian Gulf; he separated it from *L. mauritiana* by its more "chubby" axes and their broadly rounded apices. This species is also known from Australia (Cribb 1983) and South Africa (Norris 1987a).

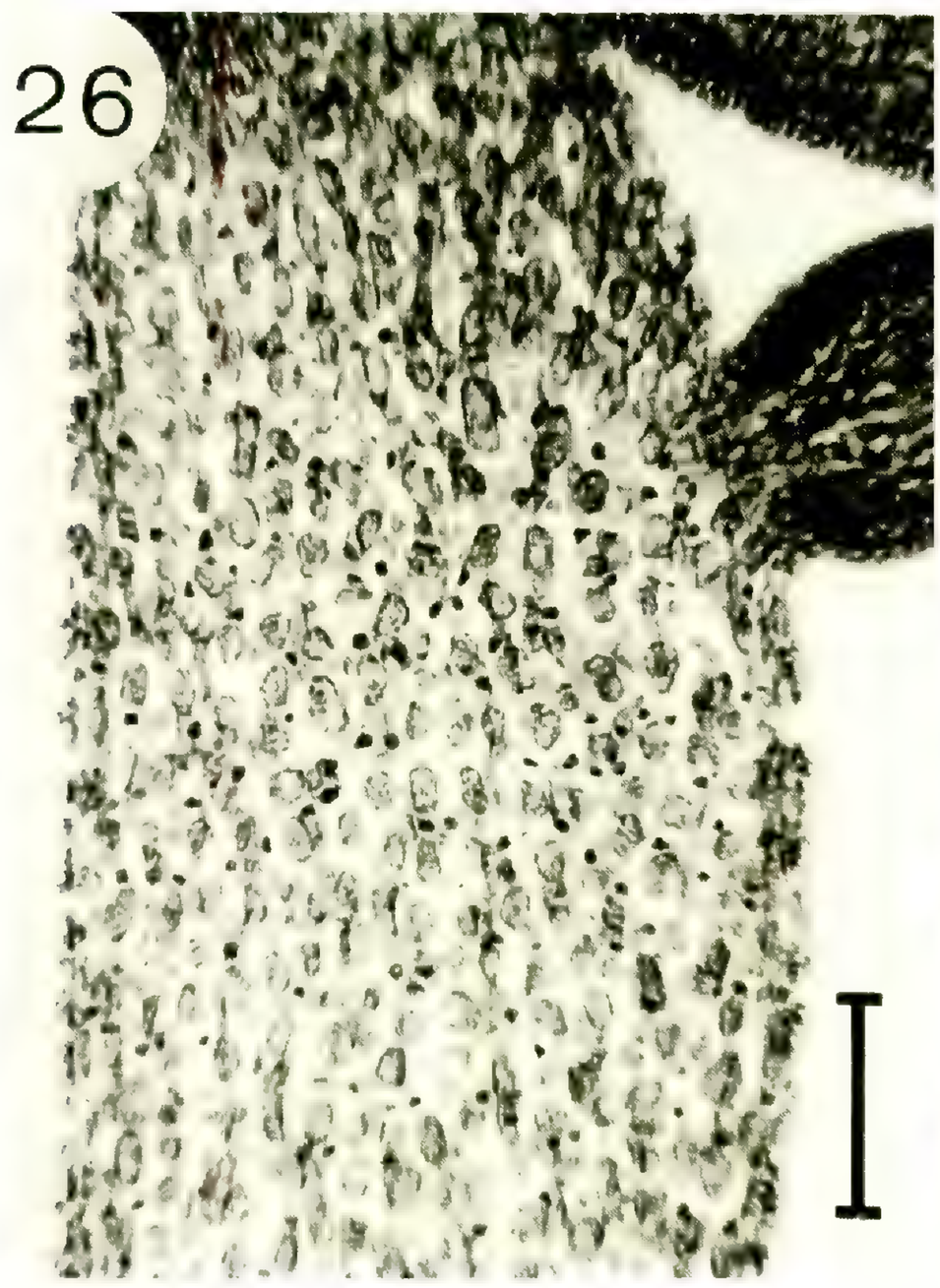
**Lomentaria mauritiana** Børgesen (1944). Figs. 25, 26.

Collection: 3E–3.

Previous Seychelles report: Kalugina-Gutnik et al. (1992).

This small alga (up to only 5–8 mm tall) occurred as an epiphyte on a seagrass. Unfortunately, it was sterile, but there is no doubt that it is a *Lomentaria*. Its axes are cylindrical and 350–550 µm in diameter. In agreement with Børgesen's (1944) description of *L. mauritiana*, rhizoids are frequently developed from the apices of the axes (Fig. 25), resulting both in attachment to the substratum and to other axes. This mutually connate habit is true for both this species and *L. corallicola* (Børgesen 1939). Cells of the surface layer (Fig. 26) are a mixture of elongate cells and small rounded cells in approximately equal numbers. Børgesen (1944) referred to the surface layer as composed of larger and smaller cells, but the former were more numerous than the latter. In some of his *Lomentaria* species





FIGS. 24–27. *Champia vieillardii*, *Lomentaria mauritiana*, and *Centroceras minutum*. Fig. 24. *C. vieillardii* (3P–17), apical portion of thallus showing lack of constrictions at the diaphragms. Figs. 25, 26. *L. mauritiana* (3E–3). Fig. 25, production of rhizoids from apices of thalli. Fig. 26, surface view of thallus showing mixture of small and large cortical cells. Fig. 27. *C. minutum* (3P–14), production of rhizoids from nodes of axes. (Figs. 24, 25, scale bar = 100 μm; Fig. 26, 27, scale bar = 2 cm.)

from the Adriatic, Ercegovic (1956) described the cortical layer as composed of larger elongate cells around which small rounded cells are interspersed. Børgesen (1944) distinguished *L. mauritiana* from his *L. corallicola* by the more slender axes and the more tapering summits of *L. mauritiana*.

## Ceramiales

### Ceramiaceae

**Anotrichium tenue** (C. Agardh) Nägeli (1862).

Basionym: *Griffithsia tenuis* C. Agardh (1828).

Taxonomic synonym: *Griffithsia schimperi* Reinbold (1907).

Collections: 3G–25 (epiphytic on crustose coralline algae); 3J–5 (cystocarpic; epiphytic on seagrass leaves).

Previous Seychelles reports: Reinbold (1907, as *Griffithsia schimperi*), Untawale and Jagtap (1989, as *Griffithsia tenuis*), Kalugina-Gutnik et al. (1992).

The creeping filaments, which are attached by well-developed unicellular rhizoidal cells, give rise to occasionally branched erect axes. Both prostrate and erect axes are composed of cylindrical cells, measuring 100–132 µm broad and 346–378 µm long at maturity. A distinctive feature of this species is the origin of lateral branches from the proximal ends of axial cells (Norris & Aken 1985).

The genus *Griffithsia* was redefined by Baldock (1976) based on several differences including the modes of production of spermatangia and tetrasporangia. In *Anotrichium* spermatangia and tetrasporangia are produced in heads that are borne singly on the enlarged basal cell of a trichoblast, whéreas in *Griffithsia* these reproductive structures are produced in fascicles located in the constrictions between vegetative cells or (for spermatangia) located in an apical cap on a vegetative cell. This redefinition of *Griffithsia* removed *G. tenuis* C. Agardh to *Anotrichium*. *Anotrichium tenue* is a widespread tropical and subtropical species.

Boudouresque and Coppejans (1982) proposed that the material from the tropical Atlantic and Indo-Pacific should be called a different species from *Anotrichum tenue* of the Mediterranean; the type of *A. tenue* comes from the Mediterranean. They suggested that the name *Griffithsia thyrsigera* (Thwaites ex Harvey) Grunow be applied to the extra-Mediterranean material. In their study of material from Natal, South Africa, Norris and Aken (1985) observed that spermatangial and tetrasporangial characteristics in the Natal specimens were intermediate between those noted for the Mediterranean specimens on the one hand and the Indo-Pacific and Atlantic specimens on the other hand. They concluded that a single species was involved, *A. tenue*. Schneider and Searles (1991) agreed with the opinion of Norris and Aken (1985).

*Griffithsia schimperi* was described from Mahé by Reinbold (1907) as an epiphyte on *Halimeda macroloba* Decaisne. This taxon was not referred to by Baldock (1976) in his treatment of the Griffithsieae. Reinbold (1907) depicted tetrasporangia to be tetrahedrally divided and to be borne terminally on enlarged pedicel cells in apparent pairs (or whorls?) from the upper ends of cells close to the thallus apex. Tetrasporangia in *A. tenue* are produced in whorls on such pedicel cells (Kapraun 1980; Boudouresque & Coppejans 1982; Stegenga 1985). Reinbold also showed the production of lateral branches from the proximal ends of axial cells. Since this latter feature is distinctive of *A. tenue*, the evidence points to the conclusion that *Griffithsia schimperi* Reinbold is conspecific with *A. tenue*.

**Antithamnion antillanum** Børgesen (1917). Figs. 28–30.

Collections: 3I–37 (tetrasporic); 3P–40 (male and tetrasporic; epiphytic on *Cheilosporum acutilobum*).

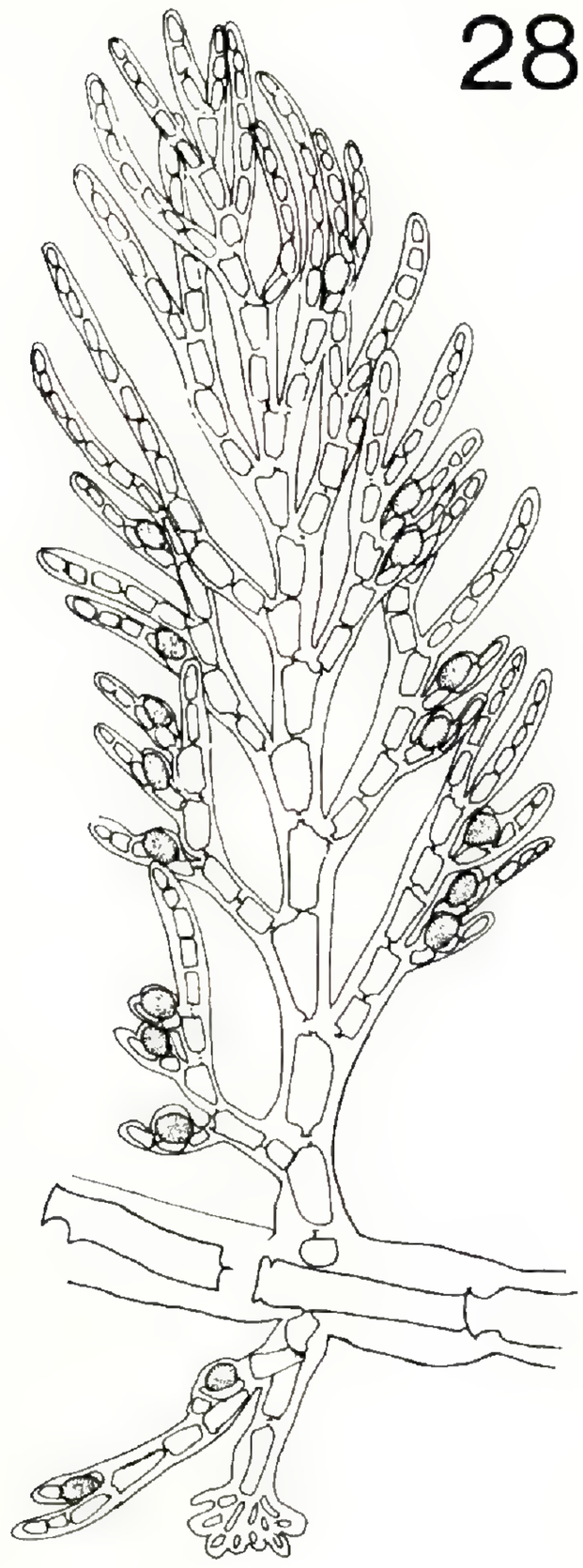
Previous Seychelles report: Kalugina-Gutnik et al. (1992, as *A. lherminieri*).

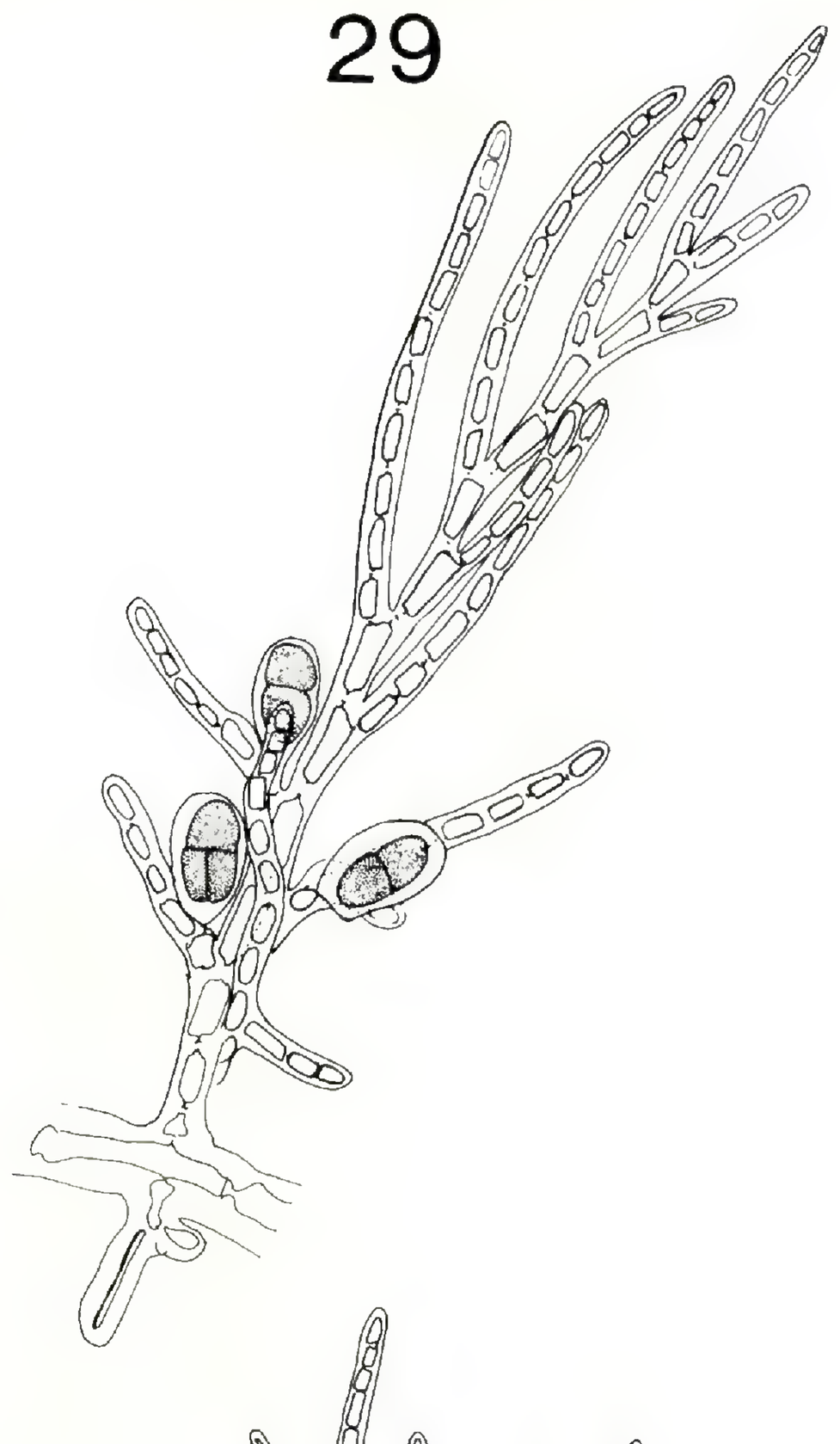
This alga has a creeping thallus, the prostrate axis giving rise to a pair of unequal-dimorphic whorl-branches from each segment (Fig. 28). One member of each pair of whorl-branches is erect, relatively well developed, to 1.0–1.2 mm tall; the other member is much reduced and often grows downward to form a rhizoidal attachment. Indeterminate lateral branches arise as a replacement of a whorl-branch. Additionally, an indeterminate branch may arise adventitiously from the first cell of an erect whorl-branch. From the first cell of the attaching whorl-branch is developed a minor erect branch. The erect whorl-branches are 16–20 cells long and bear a distichous arrangement of non-opposite branchlets. The proximal branchlets on the erect whorl-branches produce a higher order of branchlets on their abaxial sides; it is these latter branchlets that bear the gland cells, which touch two cells (Fig. 28). Gland cells are also produced on the reduced whorl-branch, in agreement with observations of others (Itono 1969; Norris 1987d, as *A. lherminieri*). Cruciately divided tetrasporangia are borne adaxially from the laterals of the whorl branches (Fig. 29). Male plants give rise to spermatangial clusters (Fig. 30) on the adaxial sides of these branchlets of higher order on the erect whorl-branches, opposite the abaxial branchlets. This appears to be the first report of spermatangial plants in this species.

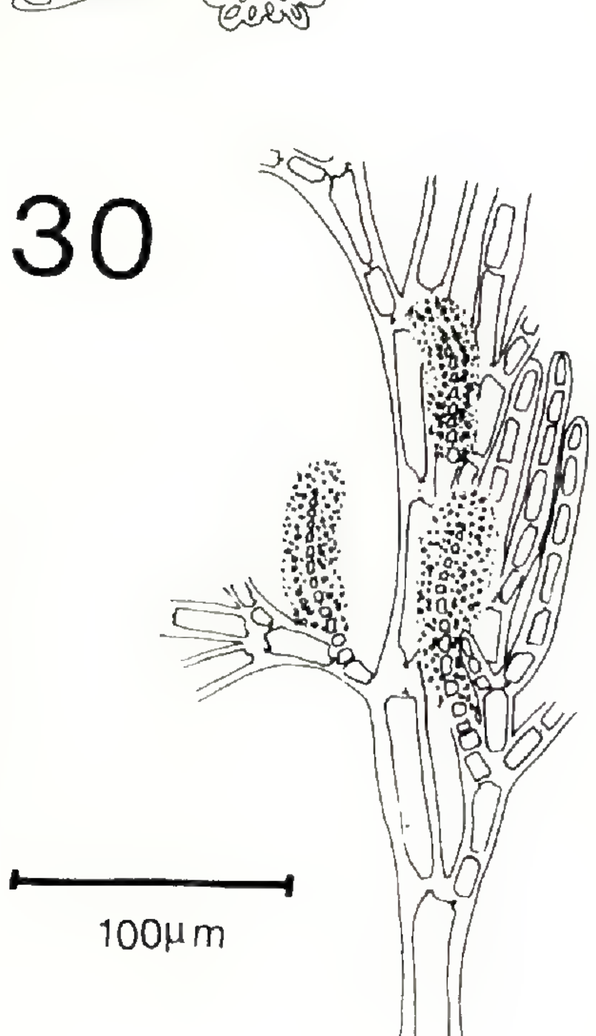
In agreement with several other workers (Dawson 1956; Itono 1969, 1977; Womersley & Bailey 1970; Athanasiadis 1985; Verlaque 1990; Tsuda 1991), the name *Antithamnion lherminieri* Nasr nom. illeg. (1941) is here regarded as a taxonomic synonym of *A. antillanum* (Børgesen 1917). Abbott's (1979) proposal to separate these two taxa depended on such alleged differences as tetrasporangia being uniformly cruciate in *A. antillanum,* but tetrasporangia occur with irregular divisions or frequently bisporangiate in *A. lherminieri.* Another alleged difference is that the gland cells are borne on short branchlets of 2–3 (rarely 4) cells in *A. antillanum*, whereas the branchlets bearing gland cells may be short or may contain many cells beyond the gland cells in *A. lherminieri.* In 3P–4A gland cells were abundant, often with the bearing branchlet extending many cells beyond the gland cell but also not so extending. The tetrasporangia in 3I–37 were uniformly cruciate. These differences do not seem to be of sufficient consistency or significance to justify the recognition of two distinct species.

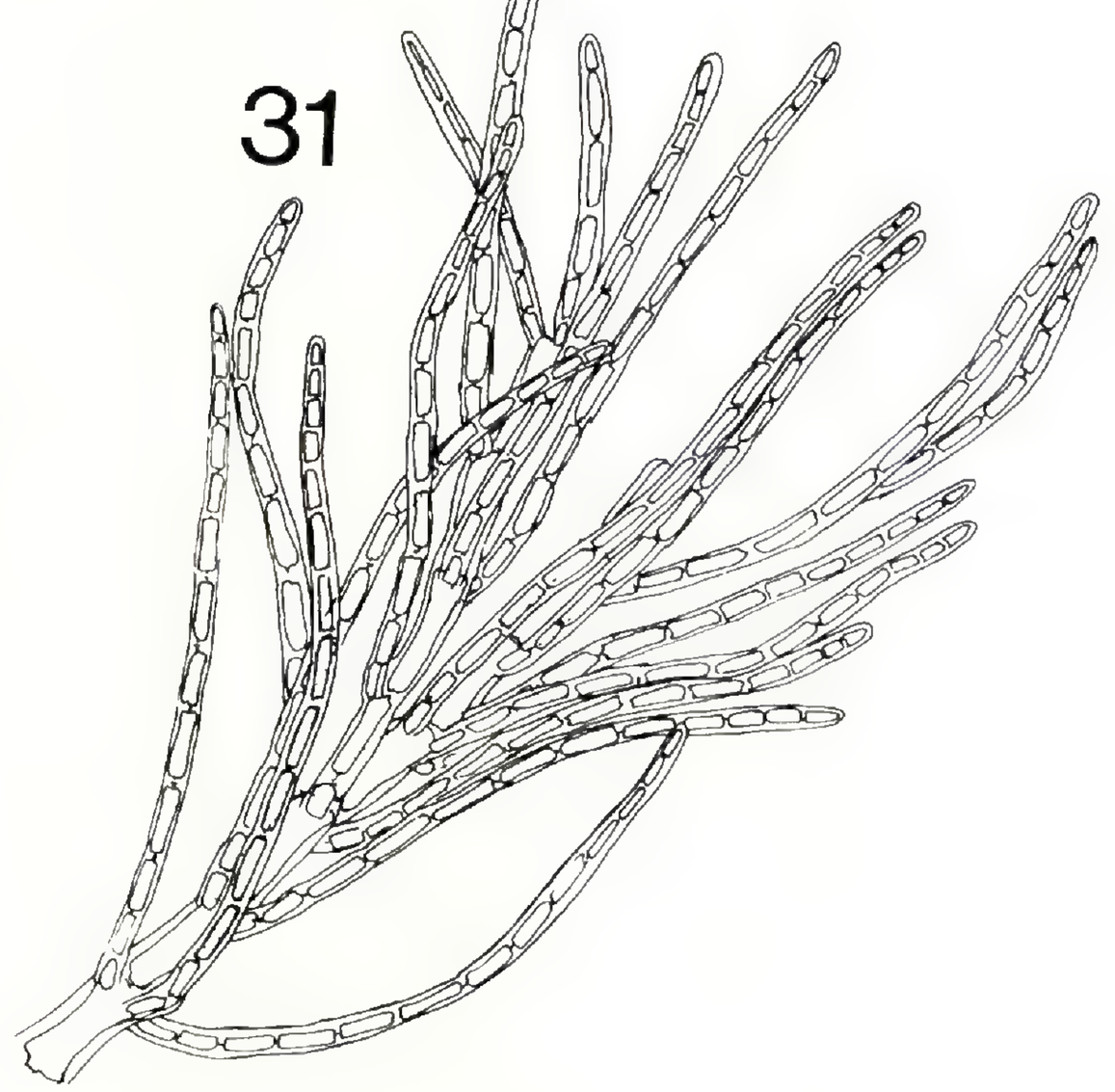
A separate problem with *Antithamnion lherminieri* Nasr is that it is an illegitimate name in light of Article 63.1 of the ICBN (Greuter et al. 1988). If Nasr (1941) is credited with the validation of *A. lherminieri*, as is done by Abbott (1979) and Silva et al. (1987), the name is automatically superfluous, since Nasr cited *A. antillanum* Børgesen in the taxonomic synonymy of *A. lherminieri.*

In their description of *Antithamnion makroklonium* from the Red Sea, Athanasiadis et al. (1990) compared several species of *Antithamnion* with either decussately arranged or alternate-distichously ramified branches. With its whorl-branches lacking opposite pairs of branchlets, *Antithamnion antillanum* could be distinguished from *A. diminuatum* Wollaston, *A. divergens* (J. Agardh) J. Agardh, *A. gracilentum* (Harvey) J. Agardh, and *A. ogdeniae* Abbott. According to Cormaci and Furnari (1987) some Mediterranean records attributed to *A. antillana* belong to *A. ogdeniae.* In the latter species opposite pairs of pinnae are present in the lower part in at least some of the whorl-branches (Pizzuto & Serio 1992).




FIGS. 28–31. *Antithamnion antillanum* and *Antithamnionella flagellata.* Figs. 28–30. *A. antillanum* (3P–40). Fig. 28, a pair of opposite whorl branches arising from a prostrate axis. Gland cells (shaded) borne on laterals of the whorl branches. Fig. 29, portion of a tetrasporangiate plant. Fig. 30, portion of a spermatangial plant. Fig. 31. *A. flagellata* (3I–34), portion of a sterile plant showing arrangement of whorl branches and the origin of one indeterminate branch.

*__Antithamnionella flagellata__ (Børgesen) Abbott (1979). Fig. 31.

Basionym: *Antithamnion flagellatum* Børgesen (1945).

Collection: 3I–34 (tetrasporic).

Plants are partially prostrate and attached by frequent rhizoidal outgrowths developing from the second cell of a whorl-branch along their length. Indeterminate axes bear whorl-branches in 2's and 3's (Fig. 31), rarely 4's. New indeterminate axes arise in the position of whorl-branches. The whorl-branches are mostly simple (Fig. 31) and are usually made up to 12–14 cells in length. Mature cells of indeterminate axes are 45–55 µm in width; cells in the mid-region of the whorl-branches are 8–10 µm in width. The basal cell of a whorl-branch is slightly shorter than the other cells in the branch. Gland cells were absent. In his description of this species from Mauritius, Børgesen (1945) stated that gland cells were rather rare and in some of the specimens entirely absent; Schneider (1984) observed gland cells to be abundant in material from North Carolina. This species has been reported from the Caribbean (Abbott 1979), Belize (Norris & Bucher 1982), North Carolina (Schneider 1984), and the east coast of Florida (Hanisak & Blair 1988).

__Callithamnion__ sp.

Collection: 3N–5 (female).

*__Centroceras minutum__ Yamada (1944). Fig. 27.

Collection: 3P–14.

In a report of *Centroceras minutum* from the Maldives (Wynne 1993), I presented arguments for its recognition as distinct from *C. clavulatum* (C. Agardh) Montagne, contrary to the taxonomic viewpoint expressed by Ardré (1987). Ardré thought that *C. minutum* seemed to be only a morphological variation of *C. clavulatum*. Although both taxa share the feature of colorless multicellular spines arising at the nodes, certain differences can be used to separate them. *Centroceras minutum* has a small stature (of 1 cm or less in height), and internodes are only 120–130 µm thick. Apices are not forcipate, unlike *C. clavulatum*, and the axes are sprawling and closely adherent to their hosts (e.g., *Cheilosporum* and *Jania*) because of the abundant production of rhizoids from most nodes (Fig. 18). Yamada (1944) described the cortical cells to be arranged in longitudinal but not in transverse rows. Also, a dichotomous habit is lacking in *C. minutum*, as pointed out by Dawson (1956). These differences seem sufficient to warrant recognition of *C. minutum* as distinct from *C. clavulatum*.

*__Ceramium affine__ Setchell & Gardner (1930). Fig. 32.

Collection: 3G–23 (tetrasporic).

Distinctive features of *Ceramium affine* include its very small size (upright axes 1–2 mm high from a creeping system attached by rhizoids), the straight apices of the erect axes, the very narrow cortical bands (of only two tiers of cells), and the naked tetrasporangia projecting singly at the node and arranged secundly (Fig. 32). Axes are up to 30 µm in diameter at the nodes, and older internodes reach up to 100 µm in length. Mature tetrasporangia, including the wall, are 45–50 µm in diameter. First described from Pacific Mexico (Setchell & Gardner 1930; Dawson 1962), this species is now known to occur also in Ecuador (Dawson 1961), the Caroline Islands (Trono 1969), southern Japan (Itono 1972), and the Philippines (Silva et al. 1987). There are morphological similarities between this species and *Ceramium codii* (Richards) Mazoyer, but in the latter species the tetrasporangia are produced in whorls and involucrated by cortical cells (Itono 1977).

FIGS. 32–35. *Ceramium affine, C. cingulatum,* and *C. filiculum prox*. Fig. 32. *C. affine* (3G–23), tetrasporangiate axes. Fig. 33. *C. cingulatum* (3G–21), apical regions of thalli. Figs. 34, 35. *C. filiculum prox*. (3I–32), cystocarpic thalli. (Figs. 32, 33, 35, scale bar = 50 µm; Fig. 34, scale bar = 100 µm.)

*__Ceramium cingulatum__ Weber-van Bosse (1923). Fig. 33.

Collection: 3G–21.

The primary axes of this species are creeping (epiphytic on *Struvea anastomosans*), and they give rise to simple erect axes reaching only 1–2 mm high. The diameter of the axes is approximately 100 µm. Eight periaxial cells are produced at each segment, and very discrete nodal belts are formed (Fig. 33), consisting of 5–6 transverse rows of cortical cells. No reproductive organs were noted. Mediterranean records attributed to *Ceramium cingulatum* (e.g., Coppejans 1977) were recently shown by Cormaci and Furnari (1991) to represent a distinct taxon, *C. giacconei*.

*__Ceramium filiculum__ Womersley (1978) *prox.* Figs. 34, 35.

Collection: 3I–32 (cystocarpic).

Many points of agreement suggest that this collection may be identified as *Ceramium filiculum*, which was stated to have a distribution including eastern, southern, and western Australia. The Seychellois plant is a small epiphyte of prostrate filaments and erect filaments (to 5 mm tall). The creeping axes are attached at their nodes by rhizoids that flare out into well-developed multicellular pads. Apices are essentially straight (Fig. 35), and branching is complanate (Fig. 34) and alternate, with 3 segments between adjacent branches, in agreement with Womersley's (1978) account. There appear to be six periaxial cells, each of which cuts off two cells acropetally and two cells proximally. Additional cell divisions may result in a mature node 8–9 cells long. Internodal spaces are relatively short, namely, only about 0.5 to 1.0 times as as long as the nodal band length. All of these features support calling this collection *Ceramium filiculum*.

Carposporophytes (Figs. 21, 22) measured up to 120 µm in diameter, which is less than the 150–250 µm value given by Womersley (1978). The absence of tetrasporangial plants precludes any comparison.

Womersley (1978) said that this species had been referred by Harvey (1855, 1862) to *Ceramium miniatum* Suhr ex J. Agardh (1851), but that alga is almost certainly different and its name is invalidated by *Ceramium miniatum* C. Agardh (1824).

__Ceramium fimbriatum__ Setchell & Gardner (1924). Fig. 37.

Collections: 3G–24 (male); 3P–33.

Previous Seychelles report: Kalugina-Gutnik et al. (1992).

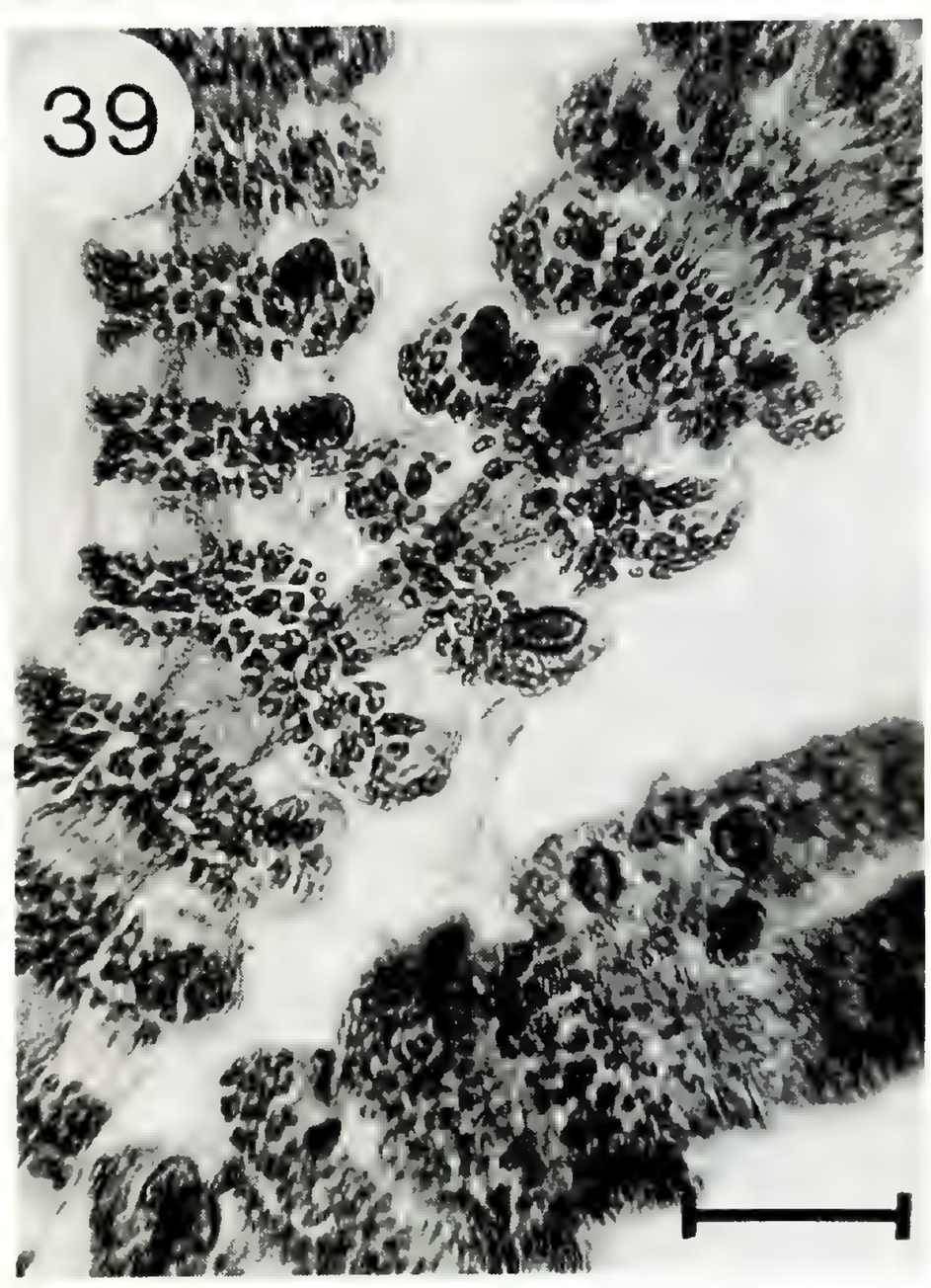
The primary distinction between this species and *Ceramium flaccidum* (see below) is the presence of whorls of unicellular bulbous hairs, arising from the distal edges of the cortical bands (Fig. 24). Womersley (1978), however, regarded the presence of these bulbous hairs as of variable occurrence and relegated *C. fimbriatum* to synonymy within *C. flaccidum*. Subsequently, Sundari et al. (1980) observed that *C. fimbriatum* is cytologically distinct from *C. flaccidum* (=*C. gracillum* var. *byssoideum*), supporting the retention of *C. fimbriatum* as a separate species. Dawson (1954a) reported and depicted this species from Vietnam.

__Ceramium flaccidum__ (Harvey ex Kützing) Ardissone (1871). Fig. 36.

Basionym: *Hormoceras flaccidum* Harvey ex Kützing (1862).

Collections: 3E–5 (tetrasporic; epiphytic on seagrass); 3G–14 (tetrasporic, cystocarpic); 3I–42 (male, cystocarpic); 3S–5 (tetrasporic); 3T–5 (tetrasporic).

Previously Seychelles report: Kalugina-Gutnik et al. (1992, as *C. taylorii*).




FIGS. 36–39. *Ceramium flaccidum*, *C. fimbriatum*, and *C. marshallense*. Fig. 36. *C. flaccidum* (3T–5), cystocarpic thallus. Fig. 37. *C. fimbriatum* (3G–24), nodal organization with hairs. Figs. 38, 39. *C. marshallense* (3I–46). Fig. 38, circinate apices. Fig. 39, tetrasporangiate thallus. (Figs. 36, 38, scale bar = 100 μm; Fig. 37, 39, scale bar = 50 μm.)

The cells of the lower portion of the cortical nodes in *Ceramium flaccidum* are transversely elongated (Fig. 36). This alga has both creeping and erect portions, the former attached by means of rhizoids developed from periaxial cells. Cribb (1983) used this origin of the rhizoids and their non-aggregated nature to distinguish *C. flaccidum* from the somewhat similar *C. punctiforme* Setchell, in which the rhizoids originate from cortical cells and become aggregated. Womersley's (1978) list of taxonomic synonyms included *C. masonii* Dawson, *C. taylorii* Dawson, as well as the familiar names *C. byssoideum* Harvey and *C. gracillimum* Harvey, which are both later homonyms and thus illegitimate (Silva et al., 1987). This species was figured from southern Japan by Itono (1972, as *C. gracillimum* var. *byssoideum*).

*__Ceramium marshallense__ Dawson (1957). Figs. 38, 39.

Collection: 3I–46 (tetrasporic).

This species was occurring as a small epiphyte on *Hypnea spinella*. Rhizoids are abundantly produced from the nodal regions. Axes are dichotomously branched, and apices are strongly forcipate (Fig. 38), which is in agreement with Dawson's (1957) description. Axes are up to about 140 µm in diameter. Nodal bands consist of a central ring of larger cells and 2(–3) irregular rows of smaller cells to either side. The nodal regions are 50–60 µm long, whereas internodal regions may be shorter (only 30 µm) to slightly longer (60–70 µm) than the nodal regions.

Tetrasporangia are borne in whorls in the erect branches (Fig. 39), but they are not as protruding as the whorls of tetrasporangia in *Ceramium vagans* (see below), nor are they as immersed as the tetrasporangia in *C. maryae* (see below).

*__Ceramium maryae__ Weber-van Bosse (1923). Figs. 40, 41.

Collection: 3P–32 (tetrasporic).

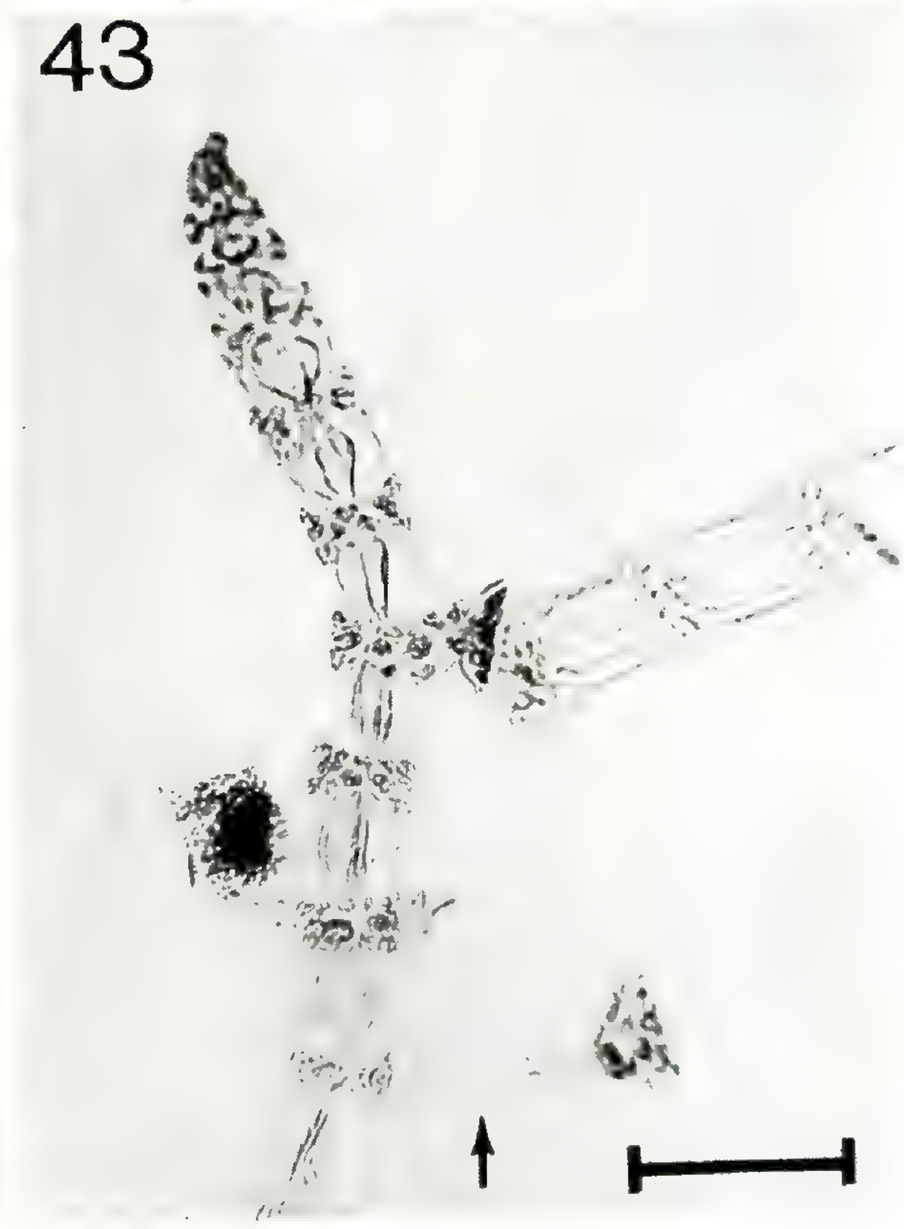
The habit of this species is essentially creeping with the production of rhizoids from most nodes. Each axial cell produces a ring of a large number of periaxial and pseudoperiaxial cells, which Cribb (1983) stated to be "approximately 20." The nodal bands consist of 6–9 (or more) very irregularly arranged rows of cortical cells. Weber-van Bosse (1923) described the tetrasporangia to be formed in a ring at the nodes and lie completely immersed within the nodal cortication (Fig. 41), not causing any protrusion of the node.

__Ceramium mazatlanense__ Dawson (1950). Fig. 42.

Collections: 3E–4 (tetrasporic; epiphytic on seagrass); 3I–23 (tetrasporic; epiphytic on seagrass); 3K–9 (tetrasporic; epiphytic on *Hypnea valentiae*).

Previous Seychelles report: Kalugina-Gutnik et al. (1992).

This alga is of small stature, consisting of creeping filaments attached by numerous rhizoids and dichotomously branched erect filaments with strongly forcipate apices. The erect filaments are only about 70 µm broad in young axes but reach 120–140 µm in breadth in mid-portions. The cortication is restricted to the nodes and is composed of small angular cells in a non-regular arrangement. Within a nodal band the proximal cortical cells tend to be large and the distal cortical cells tend to be small. The length of the internodes is approximately 2–3 (–5) times that of the nodes. Tetrasporangia are abaxially arranged in a strictly secund manner (Fig. 42); they are broadly projecting and provided with involucral outgrowths from the nodes.




FIGS. 40–43. *Ceramium maryae, C. mazatlanense,* and *C. serpens.* Figs. 40, 41. *C. maryae* (3P–32). Fig. 40, apical regions. Fig. 41, older portions with tetrasporangia (*arrows*) immersed within nodal cortication. Fig. 42. *C. mazatlanense* (3I–23), tetrasporangiate axes. Fig. 43. *C. serpens.* (3P–35), prostrate axis with rhizoid (*arrow*). (Figs. 40, 41, 43, scale bar = 50 μm; Fig. 42, scale bar = 100 μm.)

This species, originally described from Pacific Mexico (Dawson 1950), is now regarded as widely distribution in tropical and subtropical areas of the Indo-Pacific Ocean (Dawson 1954a; Jaasund 1970b; Womersley & Bailey 1970; Itono 1972; Cribb 1983).

*__Ceramium serpens__ Setchell & Gardner (1924). Fig. 43.

Collection: 3P–35.

Because this collection is scant and sterile, the identification is tentative. Yet there are several features that would point to this determination, such as the small, creeping nature of the thalli, the tips of erect axes non-forcipate, the nodal cortication limited to three rows of irregular small cells, and the rhizoids issuing from the ventral side of the nodes. Axes are about 40 μm in diameter. My observations agree with those by Itono (1972) and Schnetter and Bula Meyer (1982) for this species. Setchell and Gardner (1924) described tetrasporangia to be borne in a solitary manner in this species. Although Schnetter and Bula Meyer (1982) stated that the tetrasporangia are solitary per node, their figure (Pl. XXVI, fig. B) depicted a node with two tetrasporangia.

*__Ceramium subdichotomum__ Weber-van Bosse (1923). Figs. 44, 45.

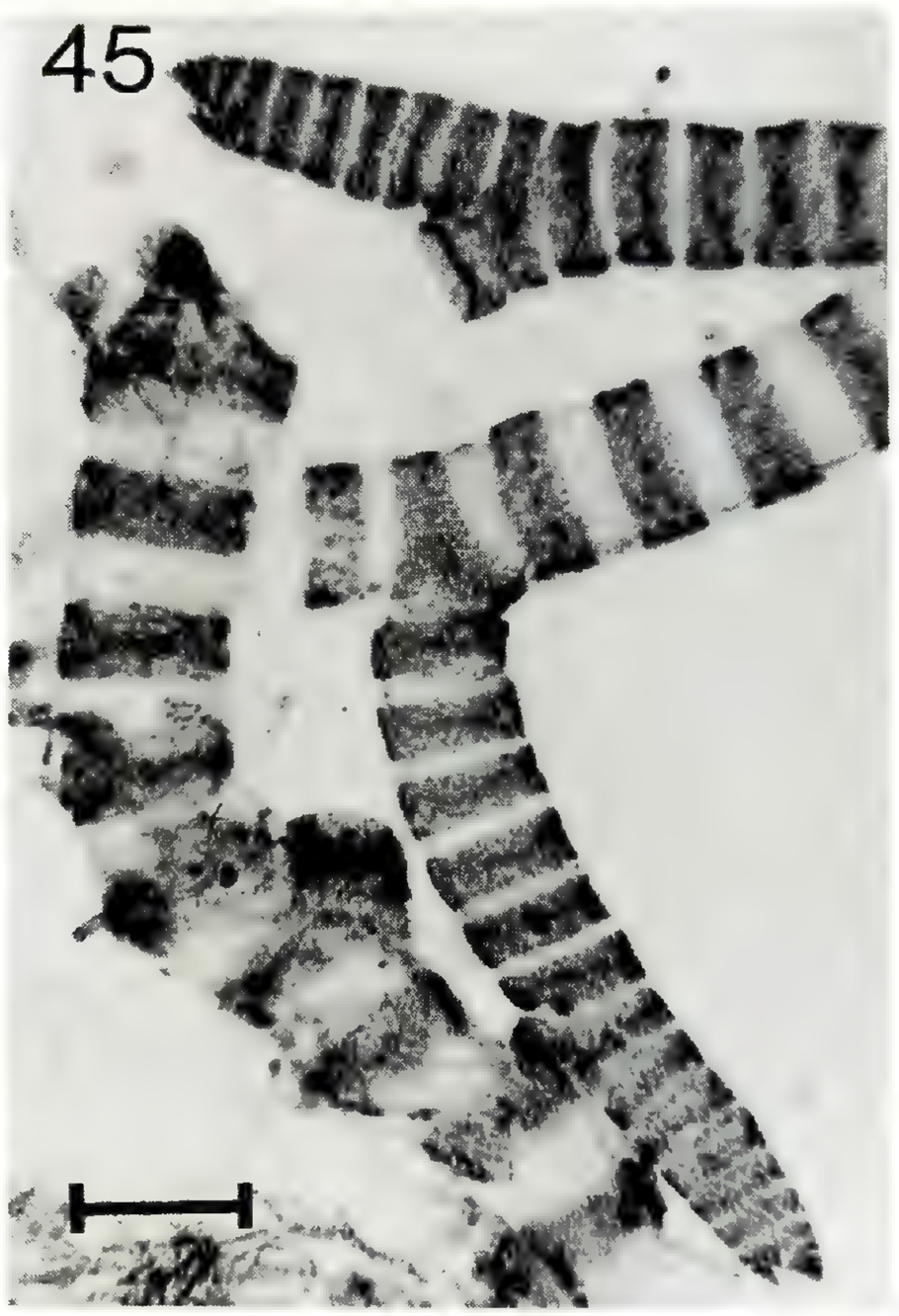
Collections: 3G–8; 3P–32.

This species was described from a collection made on the Siboga Expedition. It might be pointed out that Reinbold (1907) reported two taxa of *Ceramium* from Mahé, namely, *C. repens* Harvey and *C. kuetzingianum* Grunow var. *subverticillatum* Grunow, which were not detected in my collections.

*__Ceramium vagans__ Silva in Silva et al. (1987). Figs. 46, 47.

Collection: 3D–16 (tetrasporic).

The Seychellois plants are in close agreement with the account by Dawson (1957, as *Ceramium vagabundum*, nom. illeg.), who described this species from Enewetak, Marshall Islands. He had earlier depicted it from Pacific Mexico (Dawson 1954b, pl. 4, fig. 2, as *Ceramium* sp.). The cruciately divided tetrasporangia are produced in whorls (Fig. 47) and are surrounded by conspicuously swollen involucres. The thallus is essentially creeping (epiphytic on *Pterocladia caespitosa*) but gives rise to sparsely branched erect branches with blunt tips (Fig. 46). Branching is non-dichotomous. Branches may arise uni- or bilaterally at right angles to the parent axis. The erect axes are 84–100 μm in diameter, but the fertile areas are 160–180 μm in diameter, somewhat less than the values given by Dawson (1957). The axes are incompletely corticated. The cortical bands have even margins and consist of an inner ring of larger cells with usually two irregular rows of small angular cells to either side. The exserted whorled tetrasporangia (Fig. 47) with their prominent involucres, more developed cortication, and the erect apices (Fig. 46) in *C. vagans* distinguish this species from *C. marshallense* with its whorled tetrasporangia surrounded by a tumid cortication (Fig. 39), the strongly forcipate apices (Fig. 38), and its more narrow cortical bands. Dawson (1957) pointed out some similarity of this species to *C. nakamurai* Dawson [=*C. equisetoides* Nakamura, nom. illeg.] (Nakamura 1950, 1965), but this latter species is dichotomously branched.



FIGS. 44–47. *Ceramium subdichotomum* and *C. vagans*. Figs. 44, 45. *C. subdichotomum* (3G–8). Fig. 44, apical region of thallus. Fig. 45, older axes. Figs. 46, 47. *C. vagans* (3D–16). Fig. 46, erect apex. Fig. 47, production of tetrasporangia in whorls. (Figs. 44, 45, scale bar = 100 μm; Fig. 46, 47, scale bar = 50 μm.)

**Corallophila apiculata** (Yamada) R. Norris (1993).

Basionym: *Centroceras apiculatum* Yamada (1944).

Collection: 3P–27.

Previous Seychelles report: Kalugina-Gutnik et al. (1992, as *Centroceras apiculatum*).

Norris (1993) reported on his studies of three closely related genera of the tribe Ceramieae. In his opinion, *Centroceras*, the poorly known genus *Corallophila* of Weber-van Bosse (1923), and fully corticated species of *Ceramium* can be distinguished by the ontogeny of their corticating filaments. First, in species of *Ceramium* that have their axes covered by corticating filaments, the growth of these corticating filaments from the nodes is mostly acropetal. In the other two genera, *Centroceras* and *Corallophila*, growth of these corticating filaments from the node is predominantly basipetal. *Centroceras* and *Corallophila* can be separated, according to Norris (1993), by the fact that in *Centroceras* each pericentral cell produces a single basipetal corticating filament (with a second basipetal corticating filament being produced from the basal cell of one of the acropetal filaments), whereas in *Corallophila* each pericentral cell produces a pair of branched basipetal corticating filaments. *Centroceras* shows a production of spermatangia on fasciculate branches arising at the nodes, unlike the production of spermatangia over the entire cortex in *Corallophila* and in species of *Ceramium* that are continuously corticated.

Egerod (1971) made detailed observations on this species (as *Centroceras apiculatum*) based on a collection from Thailand and indicated that her material in its vegetative anatomy was in complete agreement with Yamada's (1944) description of this species and Dawson's (1956) published photograph. Wynne (1993, as *Centroceras apiculatum*) reported it from the Maldives. In a comparative study of species of *Centroceras* Ardré (1987) recognized *C. apiculatum*, but she regarded *C. minutum* of Yamada (1944) as merely a morphological variant of the widespread species *C. clavulatum* (C. Agardh) Montagne.

*__Corallophila howei__ (Weber-van Bosse) R. Norris (1993).

Basionym: *Ceramium howei* Weber-van Bosse (1923).

Collection: 3P–27.

Axes in this species are decumbent and 95–105 µm broad. Axial cells cut off 8 periaxial cells per segment. Cortication is almost continuous, but discrete zones of interruption separate adjacent segments (Tanaka & Pham-Hoàng 1962). The cortication of each segment is arranged in six horizontal tiers and approximately 24–26 vertical files. Sporadic cortical cells have undergone an additional division, resulting in a slightly irregular vertical arrangement. Cortical cells are squarish in outline, but cells in the proximal two rows are elongate in the vertical axis.

Ardré (1987) has provided a detailed account of the structure of *Centroceras* (now *Corallophila*) *apiculatum* Yamada, a species which she regarded as closely related to *Ceramium* (now *Corallophila*) *howei* and possibly conspecific. Ardré showed *Centroceras apiculatum* to have its periaxial cells each producing two ascending filaments and four descending filaments. In the Seychellois material here identified as *Corallophila howei* the number of ascending filaments is equal to the number of descending filaments, which is in agreement with Weber-van Bosse's illustration (1923, fig. 116b) of this species.

**Corallophila huysmansii** (Weber-van Bosse) R. Norris (1993).

Basionym: *Ceramium huysmansii* Weber-van Bosse (1923).

Collection: 3G–13 (male).

Previous Seychelles reports: Ballantine & Wynne (1986, fig. 5, as *Ceramium huysmansii*), Kalugina-Gutnik et al. (1992, as *Ceramium huysmansii*).

This alga consisted of prostrate axes (attached to dead coral) giving rise to sparingly branched erect axes. Apices were straight, non-forcipate. Mature segments appeared to have 14–18 longitudinal rows of cortical cells, and the cortical cells were usually transversely elongated, as was depicted by Weber-van Bosse (1923). Cortication was continuous, with no interruption of the cortication from one segment to the next, which separated this species from *Corallophila howei*. The cortication of male plants produced extensive spermatangial sori, such that these fertile areas were continuous along the axes (Ballantine & Wynne 1986).

***Crouania minutissima** Yamada (1944).

Collection: 3T–6 (tetrasporic; epiphytic on *Galaxaura obtusata*).

Although Yamada (1944) stated that there are four whorl-branches per segment in this very small species, other workers (e.g., Dawson 1956; Itono 1977; R. E. Norris, pers. comm.) reported that there are only three whorl-branches per segment. Itono's plants from southern Japan were only 4 mm tall and were epiphytes on *Sargassum* and *Zonaria*.

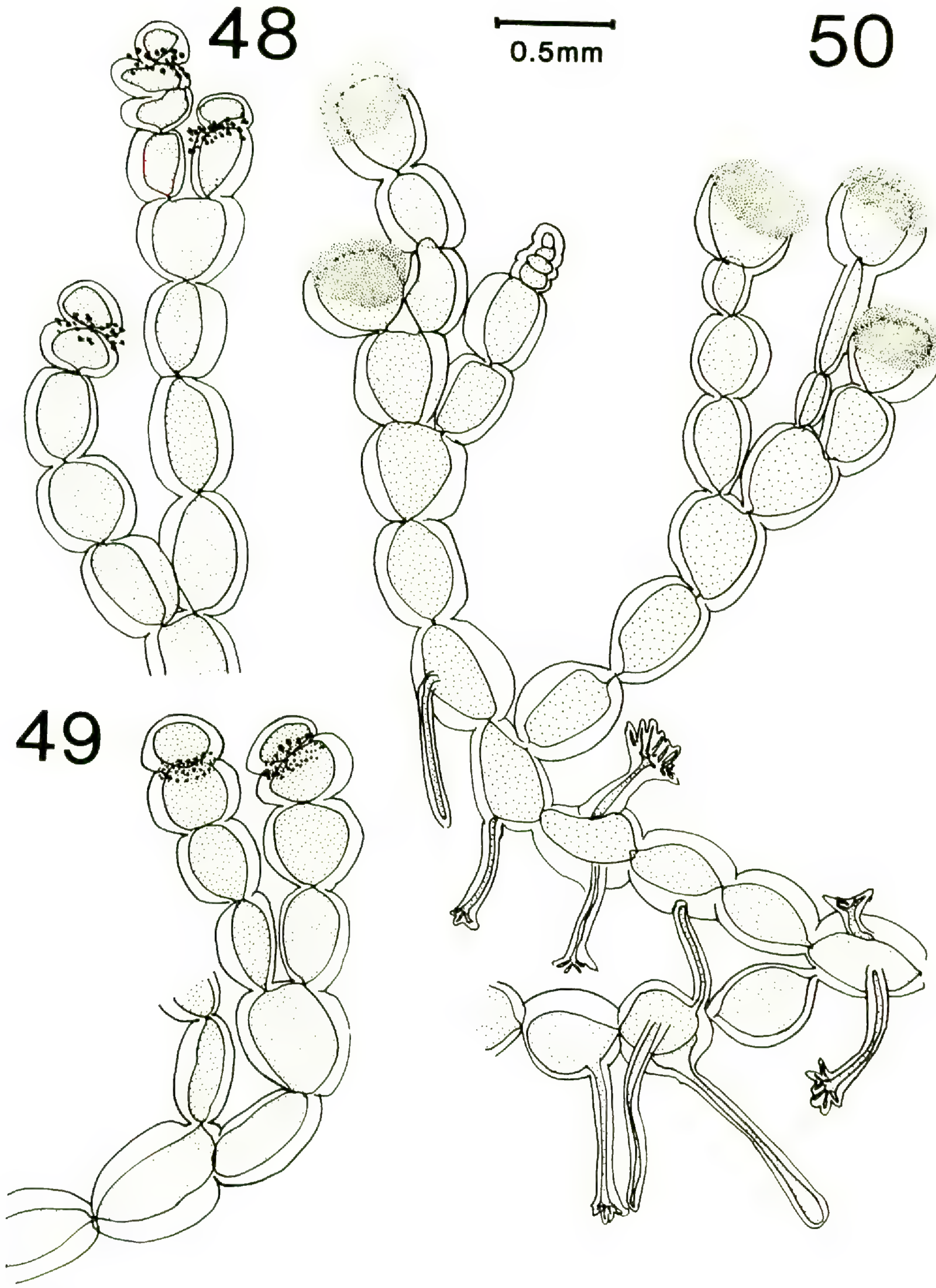
**Griffithsia weber-van-bosseae** Børgesen (1942a). Figs. 48–50.

Collection: 3K–4 (male, cystocarpic, & tetrasporic).

Previous Seychelles report: Kalugina-Gutnik et al. (1992).

When Børgesen (1942a) described this species from Mauritius, he set up the Capitatae group of the genus [="*G. capitata* group" of Baldock (1976)] to include this species as well as *G. globulifera* Harvey ex Kützing and *G. capitata* Børgesen, which are characterized by spermatangial caplike formations on globose terminal cells of the filaments (Fig. 50). *Griffithsia weber-van-bosseae* is separable from the other two species by its smaller thallus size (less than 1.0 cm tall). Tetrasporangia form annular rings lacking involucral cells in both *G. weber-van-bosseae* (Figs. 48, 49) and *G. capitata*, but the tetrasporangial rings are protected by involucral cells in *G. globulifera*. *Griffithsia globulifera*, *G. metcalfii* Tseng (1942) and *G. subcylindrica* Okamura (1930a) have also been recorded from the Seychelles by Kalugina-Gutnik et al. (1992).

Thivy and Iyengar (1963) described caplike spermatangial masses in an Indian alga, which they identified as *Griffithsia rhizophora* Grunow ex Weber-van Bosse. This species, however, was later treated as a taxonomic synonym of *G. heteromorpha* Kützing (Womersley & Bailey 1970; Ballantine & Wynne 1986). The alga depicted by Thivy and Iyengar is certainly suggestive of *G. weber-van-bosseae*, and the question becomes whether Thivy and Iyengar's alga in hand was actually *G. weber-van-bosseae* and whether *G. heteromorpha* (including *G. rhizophora*) and *G. weber-van-bosseae* represent distinct species. The account of male plants in *G. heteromorpha* by Thivy and Iyengar (1963) would be the first such report, if indeed their identification is correct. Annular rings of tetrasporangia around the upper ends of the fertile cells and lacking involucres have been described for both *G. rhizophora* (Ballantine & Wynne 1986) and *G. weber-van-bosseae* (Børgesen




FIGS. 48–50. *Griffithsia weber-van-bosseae* (3K 4). Figs. 48, 49, tetrasporangiate thalli. Fig. 50, spermatangial thalli bearing spermatangial "caps."

1942a). These two species appear to be distinguishable by the regularly subdichotomous branching of *G. weber-van-bosseae* and the irregular branching of *G. heteromorpha* (Cribb 1983; Ballantine & Wynne 1986) and also the presence of vegetative trichoblasts in *G. heteromorpha* (Ballantine & Wynne 1986) and their absence in *G. weber-van-bosseae*. Thivy and Iyengar's (1963) Indian alga would be assigned to *G. weber-van-bosseae* on these criteria. More comparative data are needed for a better separation of these two species.

**Spyridia filamentosa** (Wulfen) Harvey (1833).
Basionym: *Fucus filamentosus* Wulfen (1803).
Collections: 3K–5; 3S–2.
Previous Seychelles reports: Mshigeni (1987a), Kalugina-Gutnik et al. (1992).

**Wrangelia argus** (Montagne) Montagne (1856).
Basionym: *Griffithsia argus* Montagne (1841).
Collections: 3G–17; 3P–7.
Previous Seychelles report: Kalugina-Gutnik et al. (1992).

Delessariaceae

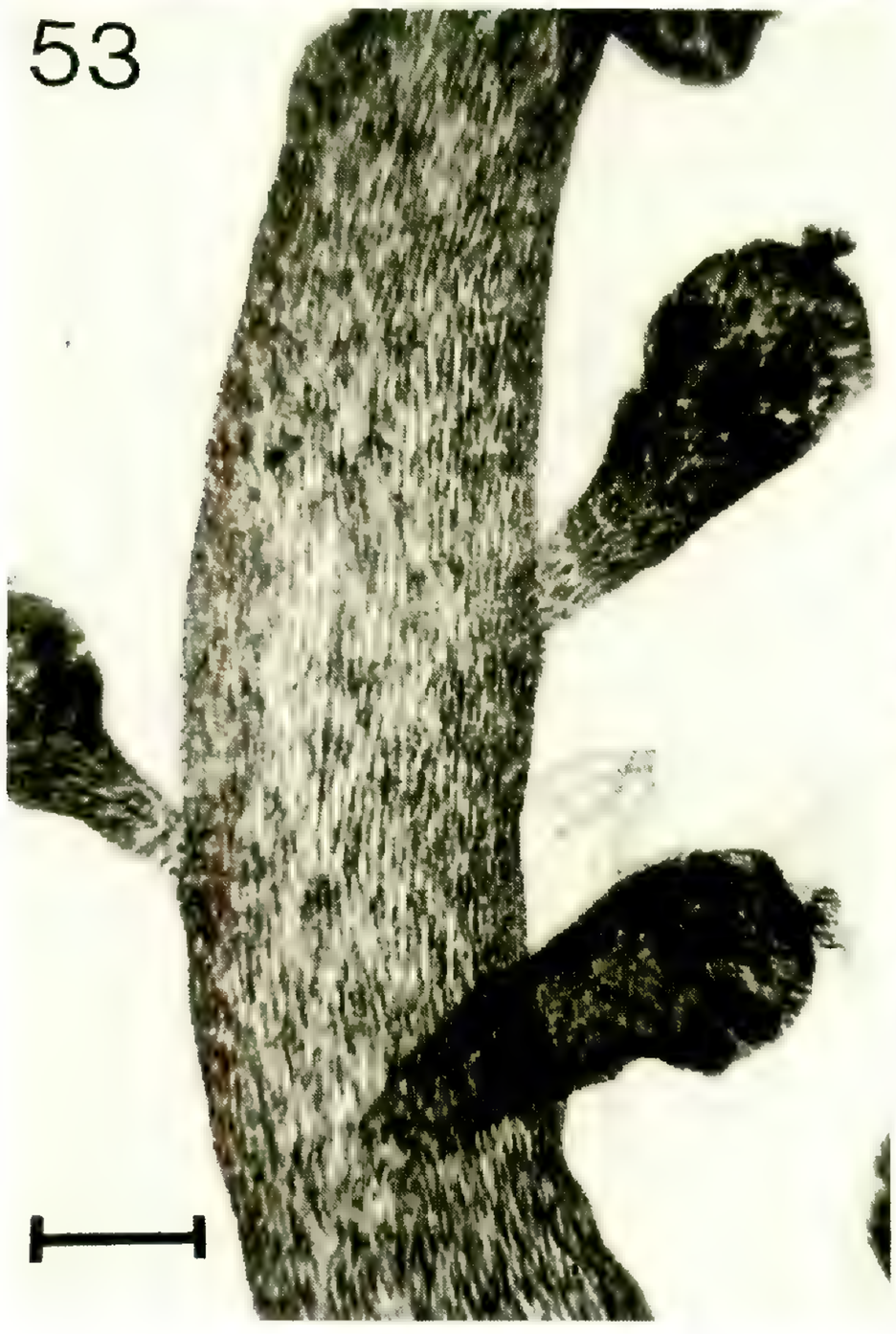
*__Delesseria__ sp.
Collection: 3K–11.
A single sterile blade, measuring only 5 mm in length and 1 mm in width, was collected. Although the fragmentary and sterile nature precludes a specific determination, it is clearly *Delesseria* on the basis of the monostromatic structure and the apical organization with intercalary cell divisions present in second-order rows and lateral pericentral cells undergoing transverse divisions. Weber-van Bosse (1923) noted that she found numerous fragmentary and non-determinable Delesserieae in her Siboga Expedition collections.

**Hypoglossum anomalum** Wynne & Ballantine (1986).
Collection: 3G–7 (tetrasporic).
Previous Seychelles report: Wynne (1989).
This highly distinctive species of *Hypoglossum* was first described from collections made in Puerto Rico in the Caribbean Sea and in the Dry Tortugas of the Gulf of Mexico (Wynne & Ballantine 1986). Its distribution was later greatly expanded by reports of its occurrence in eastern Australia and the Seychelles (Wynne 1989) and Natal, South Africa (Wynne & Norris 1991). Lateral branches almost always arise in pairs, issuing endogenously from a central cell, each bladelet emerging from the surface of the parent blade at some point between the midline and the margin of the parent blade. The tetrasporangial sorus forms a broad continuous patch over the blade, including the area of the midrib.

*__Taenioma nanum__ (Kützing) Papenfuss (1952). Fig. 51
Basionym: *Polysiphonia nana* Kützing (1849).
Collections: 3C–23 (male); 3E–7; 3P–26; 3S–28.
The short determinate branches of *Taenioma nanum* end in two monosiphonous filaments (Papenfuss 1952), whereas those of *T. perpusillum* (J. Agardh) J. Agardh end in three filaments. The determinate branches of *T. dotyi* end usually in 4 filaments but often 5 and occasionally 3 filaments (Hollenberg 1967). Although *T. perpusillum* was reported from the Seychelles (Kalugina-Gutnik et al. 1992), this appears to be the first report of *T. nanum*.

Rhodomelaceae

**Acanthophora spicifera** (Vahl) Børgesen (1910).
Basionym: *Fucus spiciferus* Vahl (1802).
Collection: 3J–3.
Previous Seychelles reports: Untawale & Jagtap (1989, Kalugina-Gutnik et al. (1992).



FIGS. 51–54. *Taenioma nanum* and *Chondria pygmaea*. Fig. 51. *T. nanum* (3E–7), male thallus. Figs. 52–54. *C. pygmaea*. Fig. 52, thallus with discoid base (3G–3). Fig. 53, tetrasporangiate thallus (3K–8). Fig. 54, male thallus with spermatangial "plate" (*arrow*) (3K 8). (Figs. 51, scale bar = 50 µm; Fig. 52–54, scale bar = 100 µm.)

*__Chondria minutula__ Weber-van Bosse (1923).

Collection: 3P–34.

This small-statured species is attached by discoid holdfasts arising from several points along its prostrate axes, which extend to about 6 mm. The simple, terete, erect axes are only 2 mm tall. Walls of pericentral cells displayed prominent refractive secondary thickenings, a feature pointed out by Weber-van Bosse (1923). Such refractive thickenings are apparently absent in the similar *Chondria pygmaea* (Garbary & Vandermeulen 1990; Cormaci et al. 1992). In agreement with Australian plants of *C. minutula* (Cribb 1983), the surface cells in the Seychellois material are strongly elongate in the direction of the axis. This feature easily separates *C. minutula* from *Laurencia pygmaea*, a species found to be co-occurring on the same host algae.

Another *Chondria* with a similar prostrate habit, giving rise to simple or subsimple erect axes, is *C. simpliciuscula* Weber-van Bosse, described from Aldabra Island in the Seychelles Archipelago (Weber-van Bosse 1913b). Reporting the occurrence of this species from the Great Barrier Reef, Price and Scott (1992) showed that the epidermal cells are regularly hexagonal in surface view and the apices are sunken, thus differing from *C. minutula* with its longitudinally elongate surface cells and its tapered exserted apices.

Since the name *Chondria minutula* Noda (1974), a later homonym of *C. minutula* Weber-van Bosse (1923) and thus illegitimate, persists in the literature (Konno & Noda 1980; Yoshida et al. 1990), the following substitute name is proposed for the Japanese species:

**Chondria nodae** Wynne, nomen novum = *Chondria minutula* Noda, Sci. Rep. Niigata Univ., Ser. D (Biol.) 11: 72, fig. 13, 1974, non *C. minutula* Weber-van Bosse (1923).

*__Chondria pygmaea__ Garbary & Vandermeulen (1990). Figs. 52–55.

Collections: 3G–3 (male, cystocarpic; epiphytic on *Caulerpa serrulata*); 3K–8 (male, tetrasporic; epiphytic on seagrass).

A small-statured but fully reproductive *Chondria* was detected as an epiphyte in two collections. *Chondria pygmaea* was described as an epiphyte on the seagrass *Halophila* in the Red Sea (Garbary & Vandermeulen 1990). This species was delineated from the similarly small-sized *C. minutula* Weber-van Bosse, because the habit of the latter species consists of a prostrate axis giving rise to short erect axes of 1–2 mm height (Weber-van Bosse 1923). The Seychellois plants are basically erect and attached with a simple discoid holdfast (Figs. 52, 55). The mature male and cystocarpic thalli of collection 3G–3 are only to 3.5 mm tall. The maximum height observed was 18 mm in a tetrasporic specimen in collection 3K–8. Tetrasporangia are produced in lateral branches with obtuse apices and constricted bases (Fig. 53). The spermatangial discs (Fig. 54) had a single marginal row of sterile cells, similar to that described by Garbary and Vandermeulen (1990).

*__Herposiphonia delicatula__ Hollenberg (1968b). Fig. 56.

Collections: 3G–3A; 3K–10 (tetrasporic); 3I–48.

The indeterminate axes are closely attached to the host (usually seagrasses) by rhizoids with elaborate multicellular pads. Determinate and indeterminate laterals arise from each segment in the characteristic d/d/d/i pattern. Determinate laterals consist of up to 10 or 11 segments (Fig. 56), in comparison with the "12–14 (–30)" range given by Hollenberg (1968b) in his description of *Herposiphonia delicatula*, and the height of these determinate laterals is 780–950 μm, less than

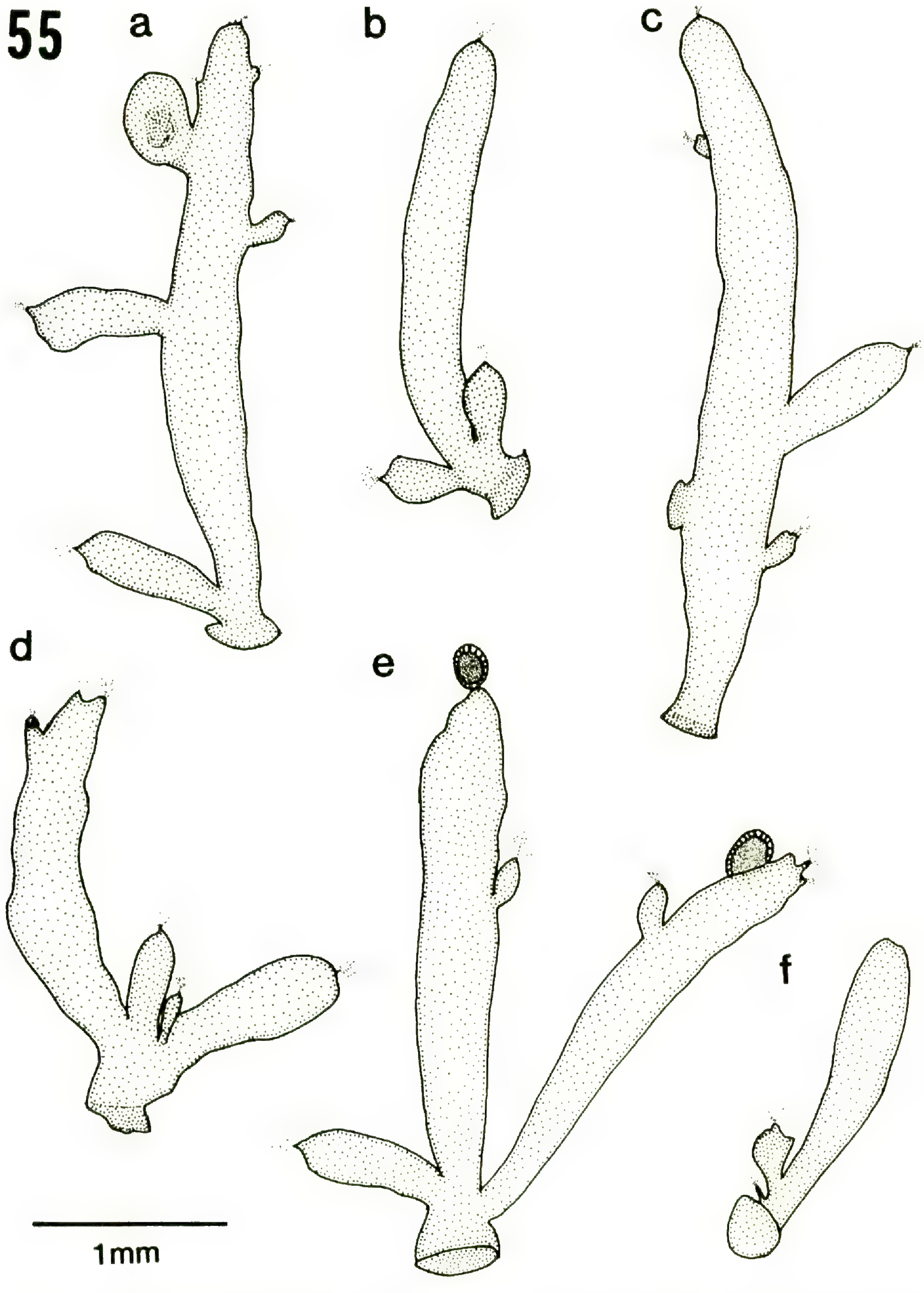
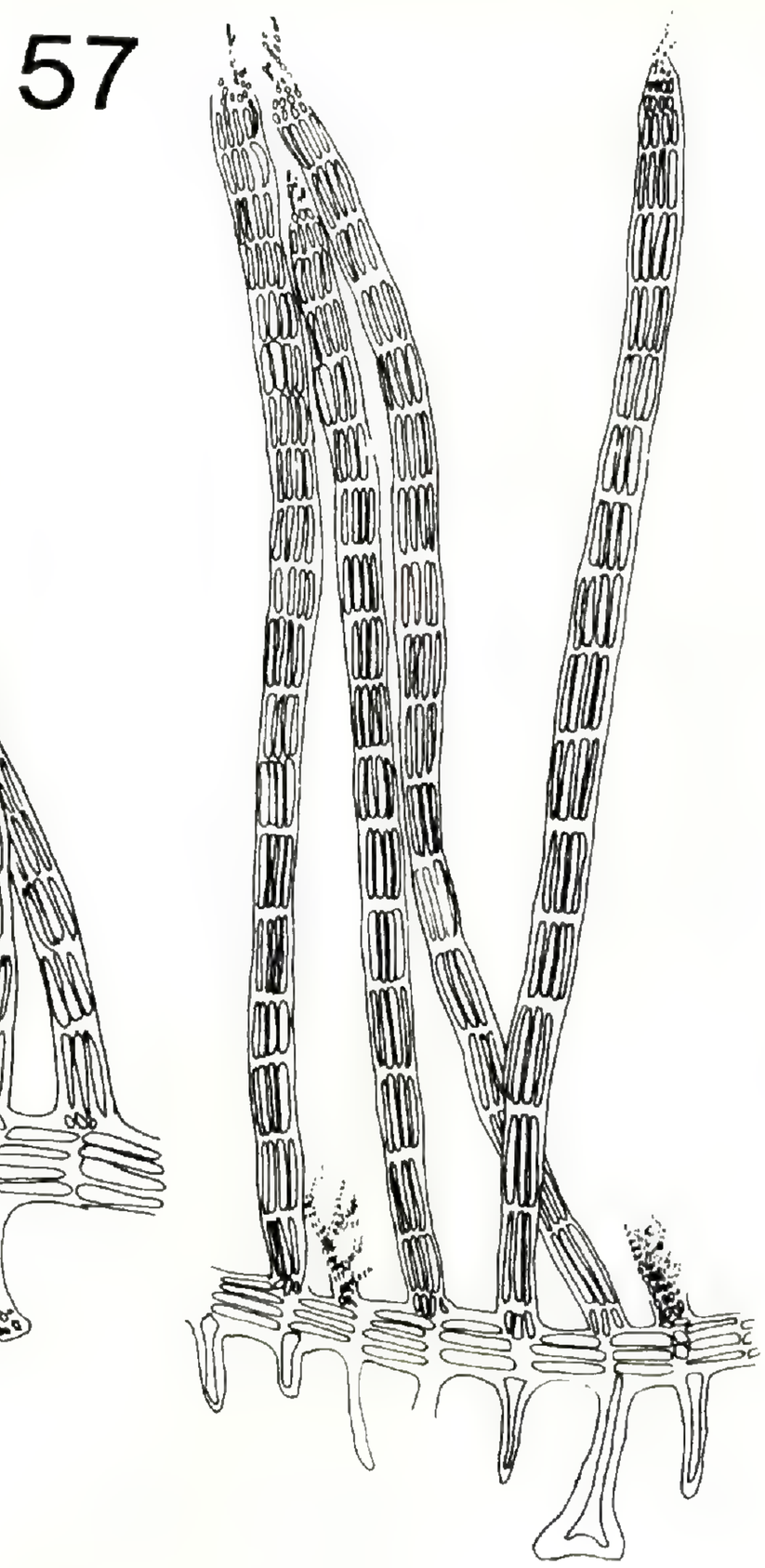
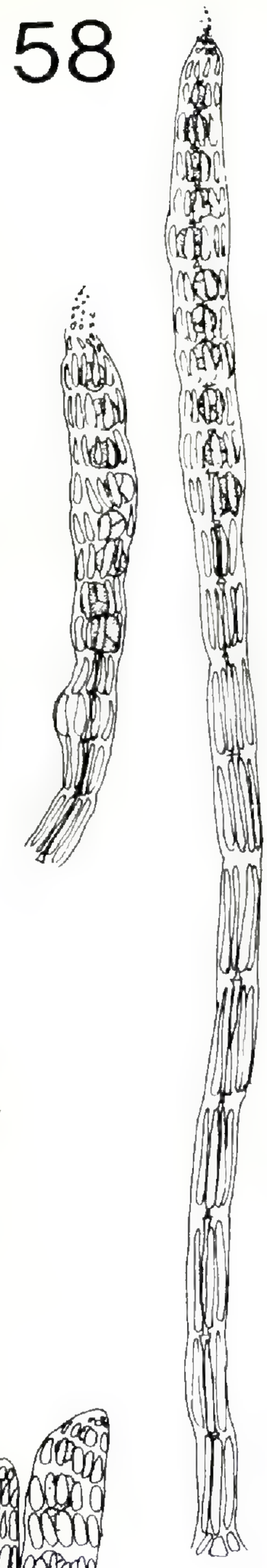
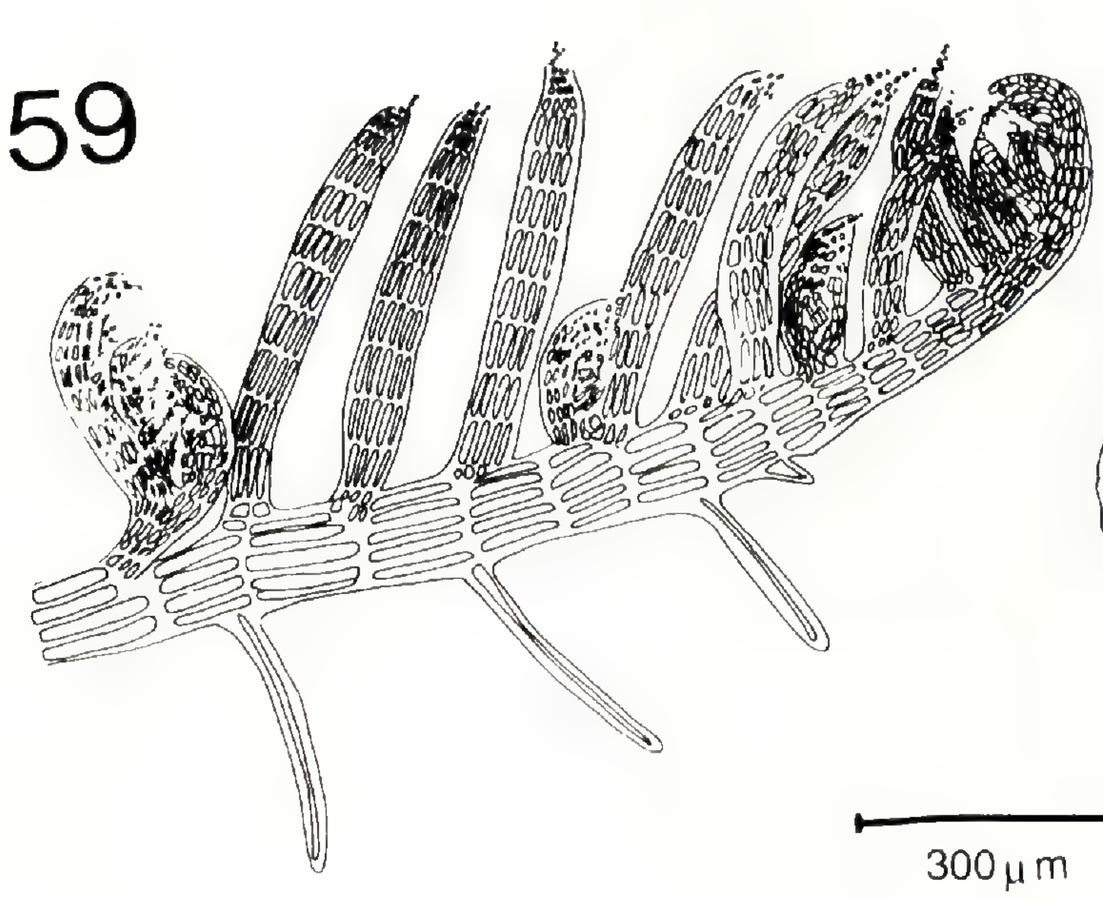


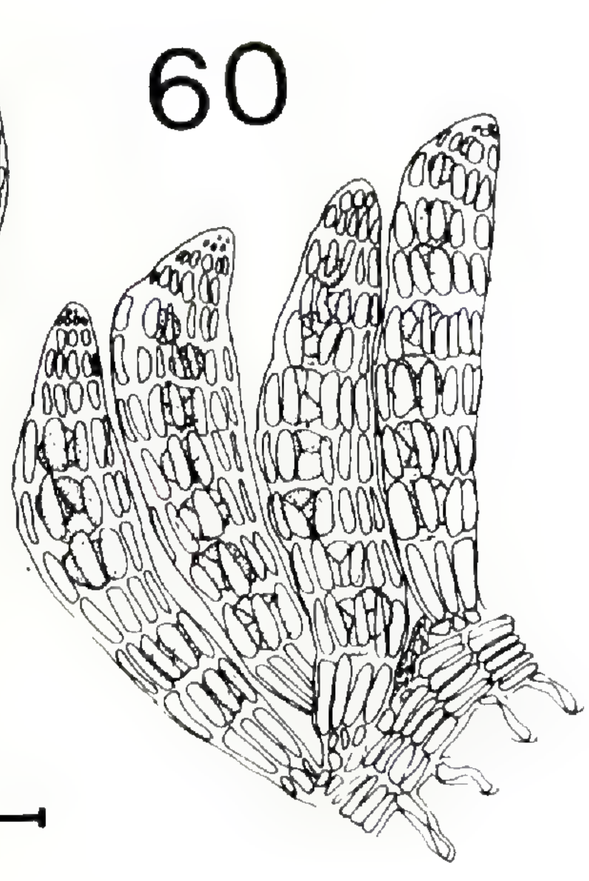

FIG. 55. *Chondria pygmaea* (3G–3). a, cystocarpic thallus. b–d, f, vegetative thalli. e, spermatangial thallus.

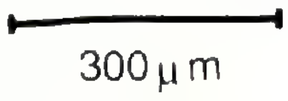
half the height of those of Seychellois plants of *H. secunda* f. *tenella*. The number of pericentral cells per segment ranged from 6–8 in both the determinate and the indeterminate axes. Determinate axes are 36–44 μm in diameter, close to the 30–40 μm range given by Hollenberg (1968b). Pericentral cells contain chloroplasts with a zonate configuration. Two or three well-developed trichoblasts usually




FIGS. 56–60. *Herposiphonia delicatula, H. secunda* f. *tenella,* and *H. parca.* Fig. 56. *H. delicatula* (3K–10), portion of creeping axis with several determinate branches and a young indeterminate branch. Figs. 57, 58. *H. secunda* f. *tenella* (3C–22). Fig. 57, portion of a creeping axis with determinate or indeterminate branches arising from every segment. Fig. 58, tetrasporangia-bearing determinate branches. Figs. 59, 60. *H. parca.* Fig. 59, growing region of a creeping axis with determinate branches of limited extent. Fig. 60, tetrasporangia-bearing determinate branches.

terminate each determinate branch. Trichoblasts are dichotomously branched several times; the basal cell is often large, measuring 150–180 µm in length and 20–22 µm in diameter. But trichoblasts are easily shed, and so the apices of many determinate branches are bare. Tetrasporangia are formed one per segment in a straight series of 5 to 7.

Hollenberg (1968b) admitted that this species "is closest to *Herposiphonia tenella*," i.e., *H. secunda* f. *tenella*, differing in being more slender, usually with fewer pericentral cells, and in producing its sexual structures in the lower part of the determinate branches. Although the Seychellois collections assigned to *H. delicatula* are not sexual, they conform to Hollenberg's account of this species and differ from the single collection determined as *H. secunda* f. *tenella* (see below). Cribb (1983) noted that within the spectrum of specimens he assigned to *H. secunda* f. *tenella* were specimens vegetatively matching *H. delicatula* as well as *H. parca* Setchell and *H. dendroidea* Hollenberg. He thought that it is possible that the vegetative characters are of a "minor nature" and that these four species may prove to be conspecific, but he recognized that sexual plants were needed for a final verdict on this question. Schneider and Searles (1991) recognized *H. delicatula* as distinct from *H. secunda* f. *tenella* on the basis of spermatangial stichidia produced in a secund series of trichoblasts on the adaxial side of the determinate laterals in the former and spermatangial stichidia produced on trichoblasts arranged spirally on the determinate laterals, accompanied by some vegetative differences in the latter.

***Herposiphonia parca** Setchell (1926). Figs. 59, 60.

Synonymy: *H. terminalis* Segi (1954); *H. tenella sensu* Okamura (1930b), non (C. Agardh) Ambronn; ?*H. vietnamica* Pham-Hoàng (1969); *H. fusca* Jaasund, nom. nudum (1976, 1977).

Collections: 3G–16; 3P–13 (tetrasporic; on coral and epiphytic on *Cheilosporum jungermannioides*); 3S–26 (tetrasporic; epiphytic on *Dictyota pinnatifida*).

After much deliberation over the identity of these Seychellois collections, an assignment to *Herposiphonia parca* seems most appropriate. The plants are firmly attached to the substrata, and typically each segment of a creeping axis gives rise to either a determinate or indeterminate branch in a d/d/d/i pattern (Fig. 59). The determinate laterals are falcate or arching distally. Plants are typically dark orange-brown, sometimes purplish. Although 9 seems to be the most common number of pericentral cells per segment, a range of 8 to 11 is possible for both determinate and indeterminate axes. Main axes are 90–140 µm in diameter; determinate laterals are 46–80 µm in diameter and reach to 11 segments. In describing *H. parca* Setchell (1926) reported the determinate laterals to consist of 5–7 segments in his probably "dwarfed" plants, but Hollenberg (1968b) reported a range of 8–12 (–20) segments. The determinate laterals bear 1–2 poorly developed terminal trichoblasts; often the tips are bare. Tetrasporangia are produced in spiral series of (3–) 6 to 8 in the mid portion of determinate laterals (Fig. 60). Sexual plants were not observed.

It is worth pointing out that the suprabasal segments of the determinate branches are distinctly longer than other segments of the branch, and the contents of these cells have a refractive property not present in the cells of other segments. This same phenomenon of distinctly longer suprabasal segments and a refractive property of these cells was observed in *Herposiphonia clavata* by Wynne (1985). *Herposiphonia clavata* is easily separated from *H. parca* on the basis of its broadly

clavate determinate branches. Similarly, distinctly longer suprabasal segments characterize *H. colombiana* (Schnetter & Bula Meyer 1982), and the shape of the determinate branches is cylindrical. The main axes in *H. colombiana* have many segments lacking branches, and there are only five pericentral cells per segment in the prostrate axes and seven pericentral cells per segment in the erect (determinate) branches of *H. colombiana*.

*Herposiphonia terminalis* Segi (1954) and Okamura's (1930b) concept of *H. tenella* are regarded as conspecific with Setchell's (1926) *H. parca* (Yoshida et al. 1990). It is noteworthy that Segi (1954) referred to the color of his *H. terminalis* as reddish brown. The evidence points to Jaasund's (1976, 1977) Tanzanian *H. fusca* as also identical *H. parca*. [It should be mentioned that Jaasund's name must be regarded as invalidly published in that he did not designate a type collection (Article 37 of the ICBN; Greuter et al., 1988)]. Tanzanian material of "*Herposiphonia fusca*" provided by Jaasund was examined and observed to be indistinguishable from the Seychellois collections assigned to *H. parca*. Jaasund (1976, 1977) reported plants of *H. fusca* as having a dark color, determinate laterals consisting of 8–10 (–12) segments, procarps developed laterally from the 8th segment, slightly upcurved tips of the procumbent axes, and young branches bearing trichoblasts that are early deciduous. The creeping axes have 9–10 pericentral cells per segment, and the semi-erect determinate branches have 7–9 pericentral cells per segment. Similarities to *H. parca* are obvious, and the identity of Jaasund's *H. fusca* ined. with *H. parca* is concluded.

Jaasund referred to *H. prorepens sensu* Schmitz (1895) as well as to "*Herposiphonia* spec." of Børgesen (1937b) as being the same as his *H. fusca*. Jaasund (1977) differentiated between genuine *H. prorepens* (Harvey) Schmitz from Natal, South Africa, and his *H. fusca* from Tanzania. The former species has determinate laterals consisting of up to 20 segments (Weber-van Bosse 1923) or "usually 18 to 20 segments, but a range of 16 to 25 segments" (Wynne 1985).

All of the features, except for the location of the cystocarps, used by Pham-Hoàng (1969) in his description of *Herposiphonia vietnamica* point to its being conspecific with *H. parca*: epiphytic, caespitose plants, prostrate axes 70–90 μm in diameter, 9 (8–10) pericentral cells per segment; determinate laterals 500–700 μm tall. Determinate laterals appear to be composed of 8–10 segments. The cystocarps are depicted as located on the 5th segment from the apex in contrast to the terminal location of the cystocarp recognized for *H. parca* (Segi 1954; Hollenberg 1968b), which seems to be the only feature permitting a tenuous separation of *H. vietnamica* from *H. parca*.

Price and Scott (1992) depicted Great Barrier Reef material that they assigned to *Herposiphonia secunda* f. *tenella* as having terminal cystocarps, a feature which they admitted to resemble *H. parca*. In Hollenberg's (1968b) distinction of these two species, he stated that the spermatangial stichidia and cystocarps are "strictly terminal" in *H. parca* but not terminal in *H. tenella* (=*H. secunda* f. *tenella*). This fact would point to *H. parca* as the identity of Price and Scott's material.

**Herposiphonia secunda** (C. Agardh) Ambronn f. **tenella** (C. Agardh) Wynne (1985). Figs. 57, 58.

Basionym: *Hutchinsia tenella* C. Agardh (1828).

Collection: 3C–22 (tetrasporic).

Previous Seychelles report: Kalugina-Gutnik et al. (1992).

This collection, including tetrasporangiate plants, conforms to Hollenberg's

(1968b, as *H. tenella*) description of this taxon. Every segment of the prostrate axes bore either a determinate or an indeterminate branch (Fig. 57). Both indeterminate and determinate axes had segments composed of 8–9 pericentral cells. Indeterminate axes were 64–72 µm in diameter; determinate branches were 50–54 µm in diameter. Determinate branches, consisting of 18–21 segments, were 1.4–1.7 mm in height and were terminated by a tuft of 2–3 trichoblasts. Tetrasporangia were produced in straight series in 10–13 consecutive segments (Fig. 58). The chloroplasts were zonately arranged in the pericentral cells, again in agreement with Hollenberg's (1968b) account. This species is also known from the Maldives (Hollenberg 1968b; Wynne 1993).

***Laurencia carolinensis** Saito (1969).

Collection: 3S–37.

This collection agrees with most characteristics as described for *Laurencia carolinensis* by Saito (1969) for this species except for the small size of the Seychellois material. Our plants reach only 1.0–1.2 cm in height, whereas a height of 5 cm was reported by Saito (1969) and 3 cm by Cribb (1983). Points of agreement include the following: origin of the cylindrical, cartilaginous axes from a discoid holdfast; axes about 1.0–1.5 mm in diameter, bearing simple clavate and slightly swollen branchlets; superficial cells not elongated radially in transection but prominently projecting at their ends and lacking secondary pit connections; and medullary cells lacking lenticular thickenings.

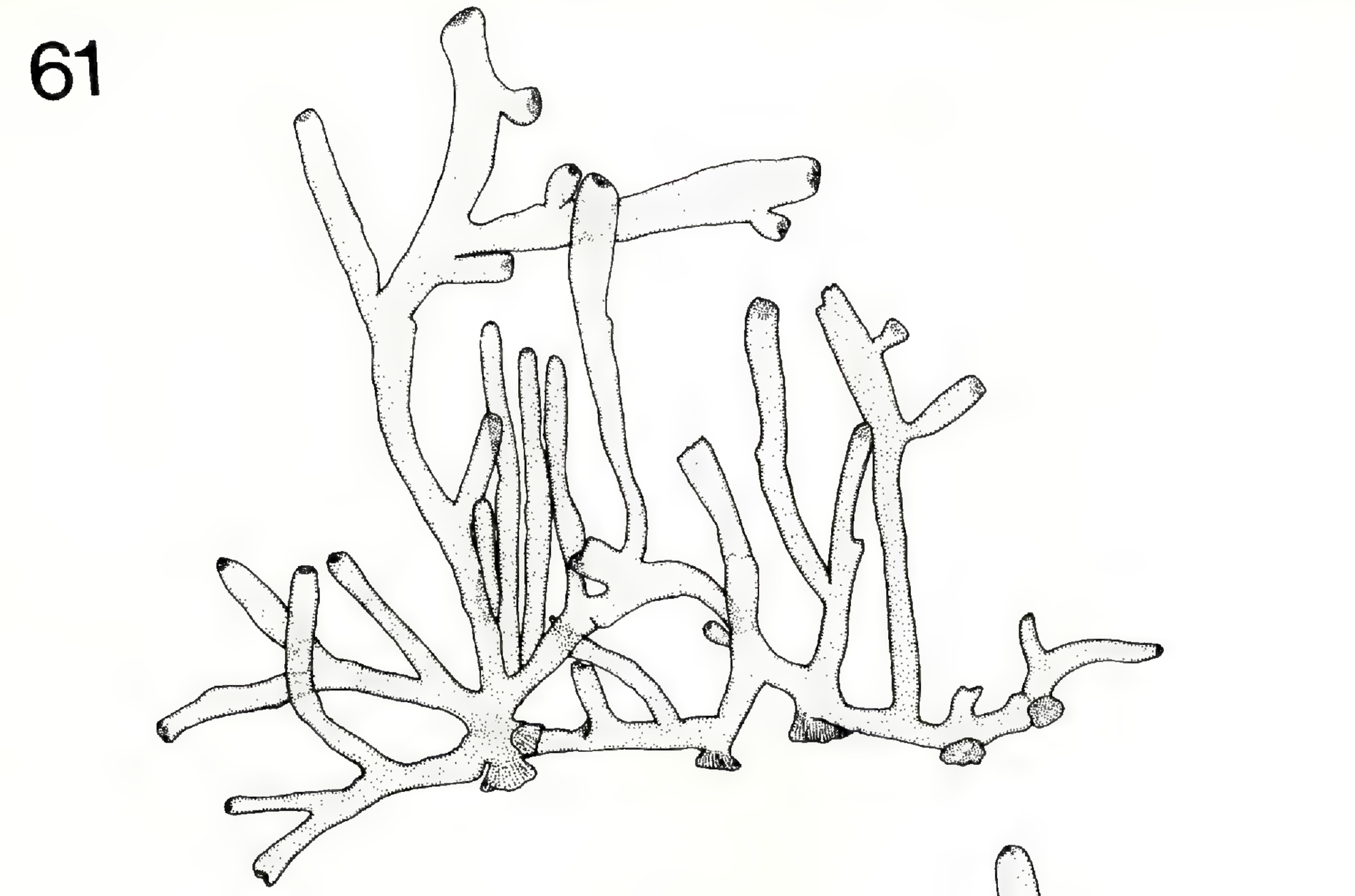
**Laurencia decumbens** Kützing (1865). Figs. 61, 62, 64, 65.

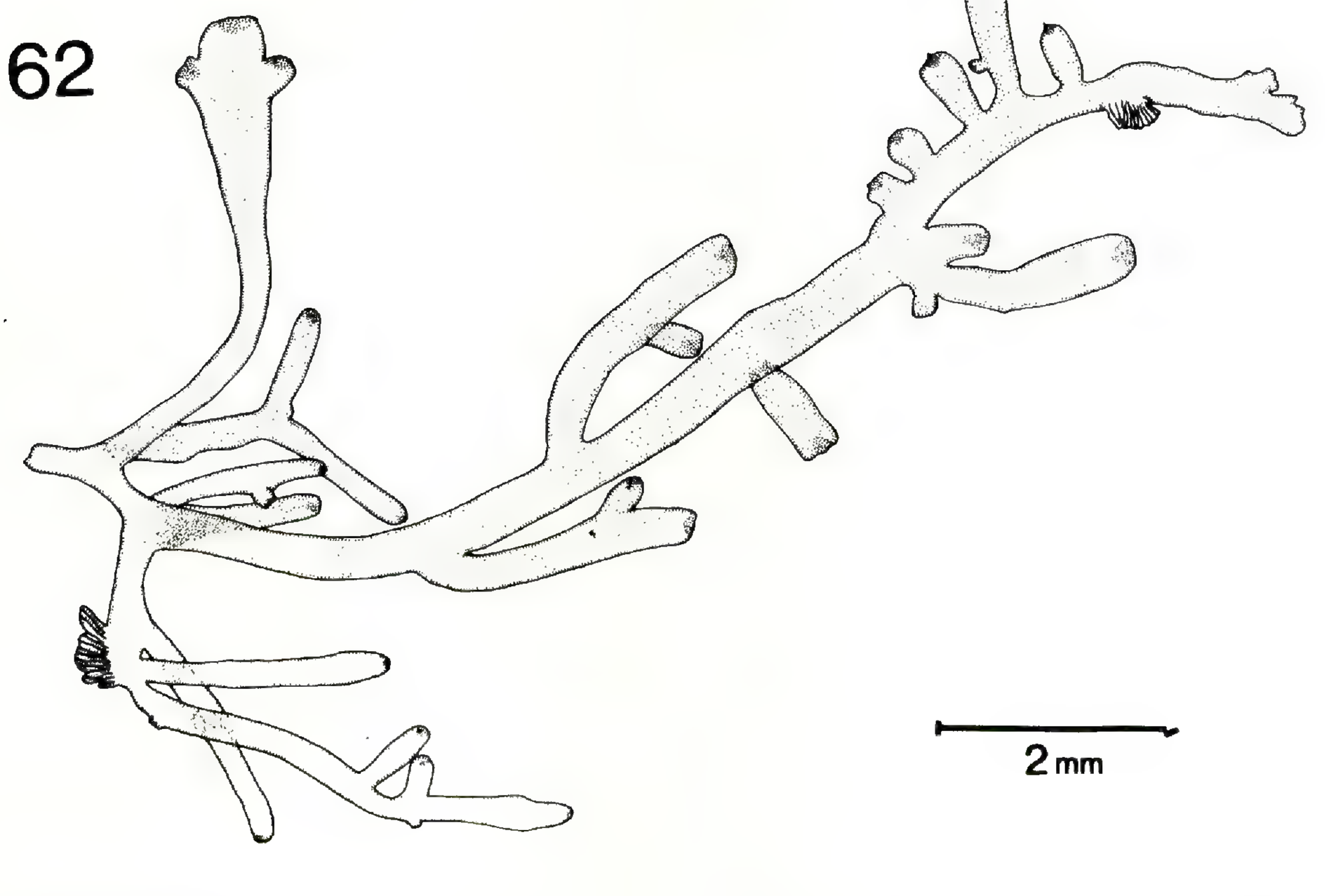
Synonymy: *Laurencia pygmaea* Weber-van Bosse (1913b).

Collections 3C–12A (epiphyte on *Laurencia papillosa*); 3K–2 (tetrasporic; epiphytic on seagrass blades); 3P–20.

Previous Seychelles report: Kalugina-Gutnik et al. (1992, as *L. decumbens* and *L. pygmaea*).

Seychellois plants of *Laurencia decumbens* (Figs. 61, 62) have decumbent axes giving rise to erect axes; both types of axes are terete with a diameter of (200–) 290–360 (–470) µm. The lower range of these measurements conforms to the description given by Weber-van Bosse (1913b, as *L. pygmaea*), but overall they are compatible with Cribb's (1983, as *L. pygmaea*) description. Erect axes in this species are diminutive. They are obtuse and truncate, with their maximum breadth just below the apex (Figs. 64, 65). Fertile axes in the present collection range from 3.0 to 8.0 mm tall. Weber-van Bosse (1913b) stated that her specimens were about 10 mm tall; Cribb (1958, as *L. pygmaea*) first reported the turf-like colonies to be "2 cm high" but later (1983) indicated that the erect branches are up to 7 mm tall. Erect axes may be sparingly branched to one or two orders. The branches are usually alternate and irregular. At times the main erect axis bears a whorl of short branchlets close to the apex, giving a crowded and subcorymbose aspect in agreement with Cribb's (1958) account of this species. Weber-van Bosse (1913b) described the branching as irregular, as well as sometimes subopposite, subverticillate, or even single. Secondary pit connections between surface cells and lenticular thickenings in the walls of medullary cells were observed. Both features are characteristic of *L. decumbens* (Saito 1969). Also, undulations in the outer walls of cortical cells in the distal parts of the plants were evident. Mature tetrasporangia are 50–74 µm in diameter. Tetrasporangia show a perpendicular arrangement, which is in contradiction to the parallel arrangement noted by Cribb (1983).




FIGS. 61, 62. *Laurencia decumbens* (3P–20), examples of thalli with multiple points of attachment to substratum.

*Laurencia decumbens*, described from New Caledonia (Kützing 1865), was thought to be most likely conspecific with *L. perforata* (Bory) Montagne largely because of the similar habit (J. Agardh 1876; Schröder 1912). Yamada (1931) examined the type of *L. decumbens*, and while noting the resemblance between these two taxa in external appearance, he pointed out that *L. decumbens* lacked the radially elongate surface cells (as seen in cross-sections) so characteristic of *L. perforata*. Børgesen (1945, 1952, 1954) reported, initially with a query and later

without such, *L. decumbens* from Réunion and Mauritius, and he described the surface cells as "nearly isodiametric, about 35–40 μ broad, but here and there some few cells longer than broad may be seen." Saito (1969) reported his determination of two specimens from Hawaii as *L. decumbens* in the herbarium of Dr. M. Doty, but there was no reference to *L. pygmaea*. Jaasund (1970a) reported *L. pygmaea* Weber-van Bosse from Tanzania and stated that *L. decumbens* is probably conspecific in that both species have a decumbent habit. *Laurencia pygmaea* was originally described from the Chagos Archipelago in the Indian Ocean. Furnari and Cormaci (1990) applied the older name *L. decumbens* and listed *L. pygmaea* in synonymy.

This species has also been reported under the name *Laurencia pygmaea* from Vietnam (Dawson 1954a; Pham-Hoàng 1969), Brazil (Oliveira F. & Ugadim 1974), East Africa (Jaasund 1976), Queensland, Australia (Cribb 1983), and Venezuela (Rodríguez de Rios & Lobo 1984). Cribb (1958) placed Setchell and Gardner's (1937) *L. clarionensis* in synonymy with a query, and Cribb (1983) also suggested that Dawson's (1954b) *L. decidua* may be conspecific.

*Laurencia decumbens* was observed to be co-occurring with *L. minuta* and *Chondria pygmaea* as epiphytes on seagrass blades. These two species of *Laurencia* are separable in that *L. minuta* is attached by a discrete discoid holdfast, whereas *L. decumbens* has a horizontal axal system giving rise to erect axes. Also, plants of *L. decumbens* tend to be distally enlarged and often bear a distal crown of laterals (see Cribb, 1983, pl 41, fig. 3); plants of *L. minuta* have a consistent diameter along their length and bear laterals at random. *Laurencia decumbens* differs from *C. pygmaea* in that the branchlets of *L. decumbens* are short, stubby, truncate at their distal end, non-constricted at their base, and surface cells of mature axes are round to ovate in outline (20–32 × 14–22 μm); the branchlets of *C. pygmaea*, however, are elongate, tapered at their distal end, conspicuously constricted at their base, and surface cells of mature axes are narrowly elongate (40–50 × 2–6 μm).

***Laurencia majuscula** (Harvey) Lucas (1935). Fig. 63.

Basionym: *Laurencia obtusa* (Hudson) Lamouroux var. *majuscula* Harvey (1863).

Collections: 3F–1 (male, female, & tetrasporangiate); 3K–7 (female).

In agreement with various accounts of this species, the Seychellois specimens are densely branched, bushy algae, which stick firmly to the paper on drying. When alive, they are bright red. Several percurrent axes may arise from the same holdfast (Saito & Womersley 1974). *Laurencia majuscula* conforms to subgenus *Laurencia* in having secondary pit-connections present between the superficial cortical cells and tetrasporangia showing a parallel arrangement (Saito 1969). The axes are terete, and cortical cells, especially close to the apices, project slightly above the surface. Cribb (1983) noted this species to produce densely plumose fronds and to be a common and distinctive species of the reef flats of the Great Barrier Reef. McDermid (1988) regarded this species to be quite variable in size in Hawaii; she also indicated it to have "corps en cerise" bodies present in the cortical cells and to have blood-red thalli. Lenticular thickenings of the walls of medullary cells are absent (Zhang & Xia 1985, 1988). This species was not included in the list of nine species and five unnamed taxa of *Laurencia* reported from the Seychelles by Kalugina-Gutnik et al. (1992).

FIGS. 63-65. *Laurencia majuscula* and *L. decumbens.* Fig. 63. *L. majuscula* (3F–1), herbarium specimen. Figs. 64, 65. *L. decumbens* (3P–20). Fig. 64, apical portion of thallus. Fig. 65, decumbent axis producing erect branches. (Figs. 63, scale bar = 3 cm; Figs. 64. 65, scale bar = 100 μm.)

***Laurencia minuta** Vandermeulen, Garbary & Guiry (1990). Figs. 66–70.

Collection: 3K–12 (male, female, tetrasporic).

*Laurencia minuta*, described from the Red Sea (Vandermeulen et al. 1990), was distinguished on the basis of the smaller size (up to 3.5 mm tall), the discoid holdfast rather than having decumbent axes, the absence of lenticular thickenings of walls of medullary cells, the parallel arrangement of the tetrasporangia (Figs. 66, 68), and the simple to subsimple nature of the axes. The features shown in the Seychellois plants agree with the description, although the heights of the Seychellois material reach 11 mm. Yet, some fully fertile plants (Figs. 66, 67, 69) were only 4–5 mm tall. It is concluded that an identification with *L. minuta* is the most appropriate assignment.

*Laurencia minuta* may be indistinguishable from *L. minuscula*, another dwarf species, which was described from the Caribbean coast of Colombia by Schnetter (1975). It was not mentioned by Vandermeulen et al. (1990). Both species belong to subgenus *Laurencia*. Plants of *L. minuscula* have a percurrent primary axis with one or two orders of laterals. Schnetter (1975, figs. 1, 2) depicted the branching to be abundant in *L. minuscula*. Plants of *L. minuta* are simple or sparingly branched. Another apparent difference would be the presence of lenticular thickenings in walls of medullary cells in *L. minuscula* and their absence on *L. minuta*. This characteristic, however, was regarded by Saito and Womersley (1974) to be variable in its occurrence in some species, and thus they found it not practicable to separate the Section *Forsterianae* on this trait. Furthermore, Furnari and Cormaci (1990) described an alleged "sister taxon" of *L. minuta* in the Mediterranean, subsp. *scammaccae*, which differed from the nominate subspecies only in having refractive thickenings of the cell walls of the medullary cells. This Mediterranean-based subspecies of *L. minuta* appears to remove one of the distinctions between *L. minuta* and *L. minuscula*; however, the difference in the branching pattern, i.e., simple or subsimple in *L. minuta* and branching to two orders in *L. minuscula*, is used to distinguish these two species.

**Laurencia papillosa** (C. Agardh) Greville (1830).

Basionym: *Chondria papillosa* C. Agardh (1822).

Collection: 3C–12.

Previous Seychelles reports: Mshigeni (1987a), Untawale & Jagtap (1989), Kalugina-Gutnik et al. (1992).

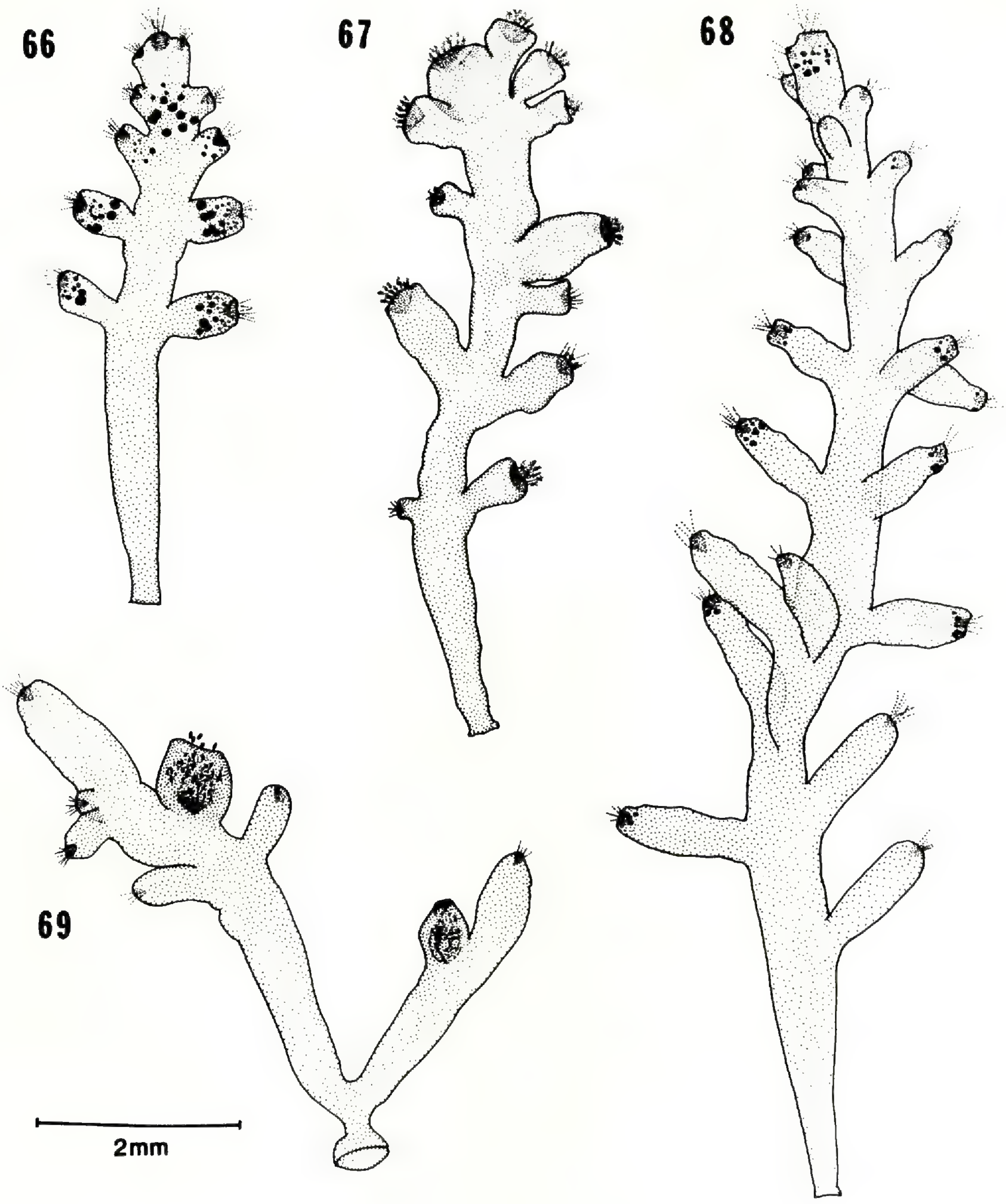
Regarding the authorship of this taxon, Papenfuss (1968) pointed out that the usually accepted basionym, *Fucus papillosus* Forsskål, is a later homonym and thus illegitimate. On the basis of Article 72.1 of the ICBN, *Chondria papillosa* C. Agardh (1822) can be treated as a nomen novum. There are taxonomic synonyms predating *Chondria papillosa*, but until type specimens of those taxa are examined and verified, it is prudent to accept the above nomenclature.

**Laurencia parvipapillata** Tseng (1943).

Collections: 3I–30; 3S–8.

Previous Seychelles report: Kalugina-Gutnik et al. (1992).

This species is characterized by strongly compressed axes with the final order of branches truncate and distichously arranged. The height of the plants is only 2 cm, compared with 4 cm in the original account (Tseng 1943) and 5 cm in Saito's (1969) account of Hawaiian and Philippine material. In agreement with these, the Seychellois plants are very cartilaginous and rigid without any attachment to the



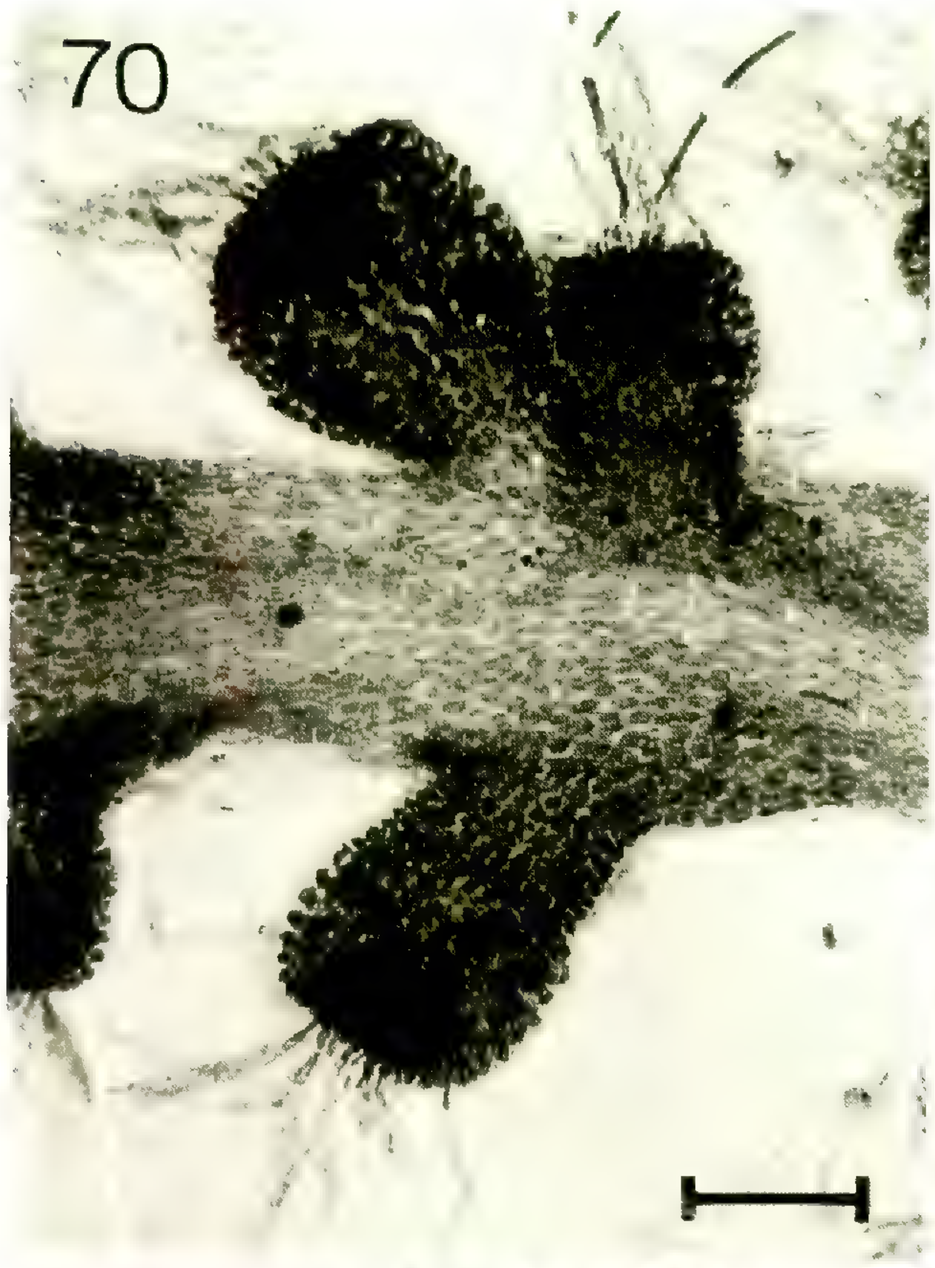

FIGS. 66–69. *Laurencia minuta* (3K–12). Figs. 66, 68, tetrasporangiate thalli. Fig. 67, male thallus. Fig. 69, cystocarpic thallus.

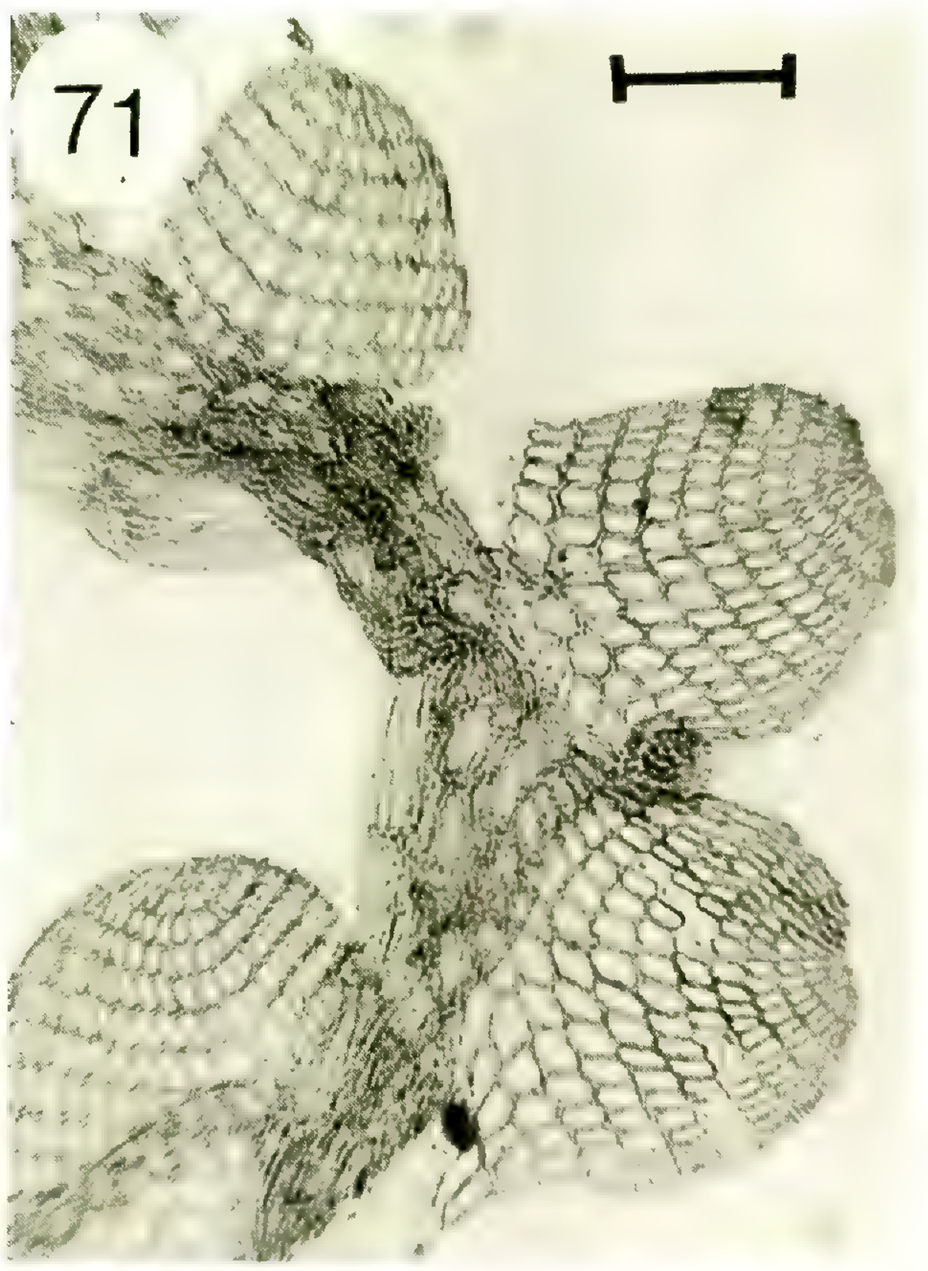
paper when the specimens are pressed. The epidermal cells are noticeably mammilate and project at the apices of branches; in transections of the axes the epidermal cells are radially elongate. The Seychellois collections were not fertile. This species appears to be widespread in the tropical waters of the IndoPacific.

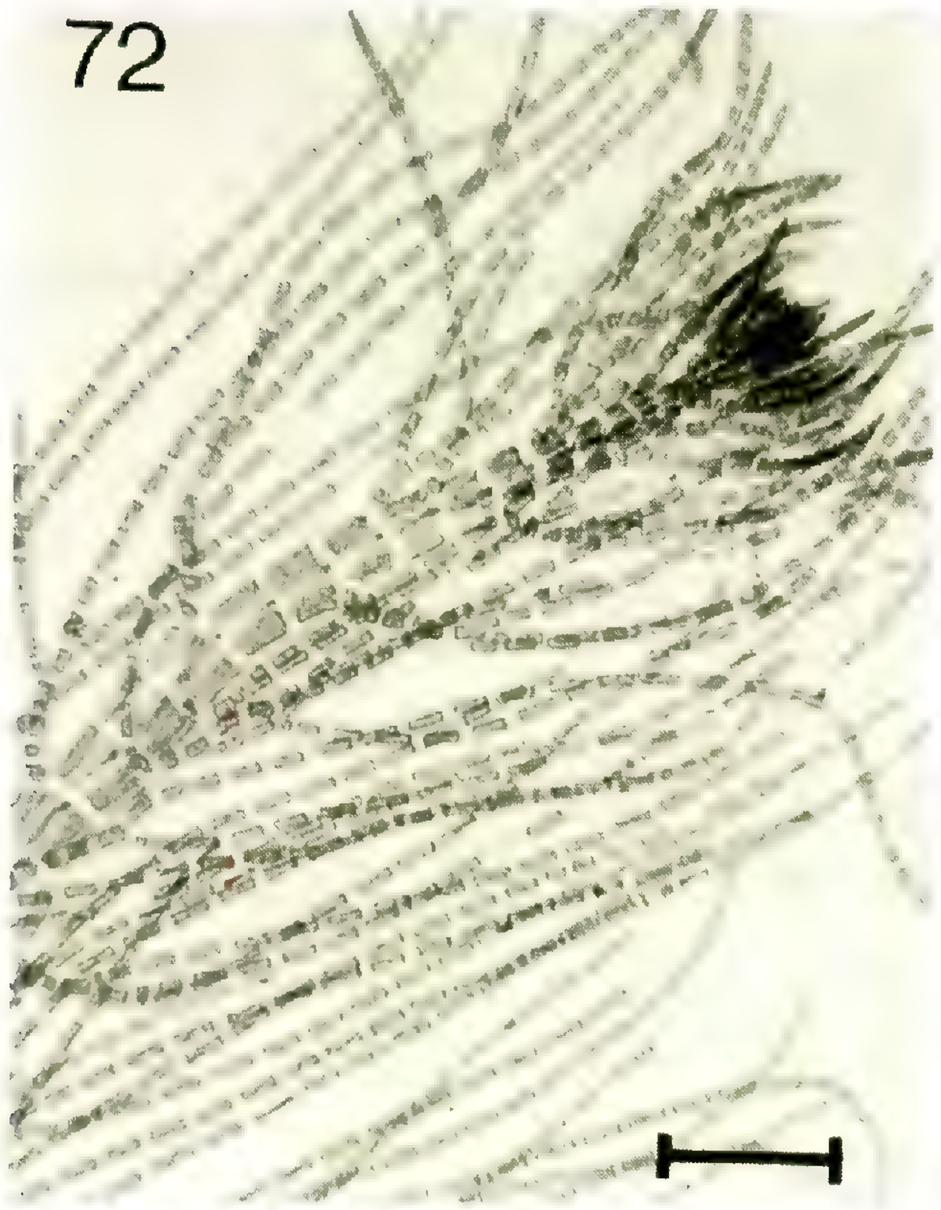
***Laurencia surculigera** Tseng (1943).

Collection: 3S–4 (tetrasporic; in rock crevices and under ledges).

The plants of *Laurencia surculigera* have a well-developed prostrate system of terete axes giving rise to arching erect axes, which often become secondarily attached to the substratum. The plants reach 2–3 cm in height, and axes are about



FIGS. 70–73. *Laurencia minuta, Leveillea jungermannioides,* and *Murrayella periclados.* Fig. 70. *L. minuta* (3K–12), tetrasporangiate branches. Fig. 71. *L. jungermannioides* (3S–10), vegetative thallus. Figs. 72, 73. *M. periclados* (3C–2). Fig. 72, apical region of thallus. Fig. 73, young tetrasporangiate stichidium. (Figs. 70–72, scale bar = 100 μm; Fig. 73, scale bar = 50 μm.)

1 mm in diameter. The texture is somewhat cartilaginous in agreement with Saito's (1969) characterization of this species, even though Tseng (1943) described the plants as "softly fleshy." Ultimate branches are 1–3 mm long, often secundly arranged, clavate to truncate, and rounded at the apices. In transections of axes, the epidermal cells are radially elongate, with the palisade arrangement as noted

by Tseng (1943). There are no secondary pit connections between epidermal cells. The walls of medullary cells lack lenticular thickenings. Pressed plants are dark purple and do not adhere to the paper. The tetrasporangia are borne close to the tips of the ultimate branches and are in a perpendicular arrangement.

The presence of articulations led to an initial incorrect identification of this collection as *Laurencia articulata* Tseng (1943), a species which has been reported from the Seychelles (Kalugina-Gutnik et al., 1992). *Laurencia surculigera* differs from *L. articulata* in that the latter species has subquadrate epidermal cells and walls of medullary cells with refractive thickenings (Zhang & Xia 1985). Tseng (1943) stated that annular scars, resulting in an articulated aspect, occur in three other species of *Laurencia* in addition to *L. articulata*: *L. flagellifera* J. Agardh, *L. longicaulis* Tseng, and *L. jejuna* Tseng. In *L. flagellifera* branching is sparse, and the plants, arising from a large basal disc, form dense tufts 8–9 cm high (Børgesen 1937a). Branching in *L. longicaulis* is congested close to the apices, giving a cymose aspect, whereas in *L. jejuna* the final branches are strongly swollen and crowded on minor branches (Tseng 1943). In the present collection of *L. surculigera* the articulations appear to be the result of regeneration after growing points have been grazed.

**Leveillea jungermannioides** (Hering & Martens) Harvey (1855). Fig. 71.

Basionym: *Amansia jungermannioides* Hering & Martens in Martens & Hering (1836).

Collections: 3C–9A; 3S–10 (epiphytic on *Dictyota pinnatifida*).

Previous Seychelles reports: Mshigeni (1987a), Kalugina-Gutnik et al. (1992).

Morphological descriptions of this handsome alga have been presented by Scagel and Chihara (1968) and Zhang and Xia (1979).

**Murrayella periclados** (C. Agardh) Schmitz (1893). Figs. 72, 73.

Basionym: *Hutchinsia periclados* C. Agardh (1828).

Collection: 3C–2 (tetrasporic).

Previous Seychelles report: Mshigeni (1987a).

Some of the plants bore localized excrescences that initially were regarded as a possible red algal parasite, but reproductive structures were not detected. John West (in litt., 15. Jan 1992) examined the material and concluded that the outgrowths appeared to be merely hypertrophications of both axial and pericentral cells. *Murrayella periclados* is not known to be associated with any alloparasite or adelphoparasite (Goff 1982).

***Ophidocladus simpliciusculus** (P. Crouan & H. Crouan) Falkenberg (1901). Fig. 79.

Basionym: *Polysiphonia simpliciuscula* P. Crouan & H. Crouan (1852).

Collection: 3C–1 (tetrasporic).

This alga forms extensive red-brown tufted growths covering upper littoral rocks. The thallus organization consists of creeping and erect non-corticated, polysiphonous axes characterized by a very high number of pericentral cells. The erect axes are sparingly branched. Apices of the erect axes bear conspicuous, often persistent tufts of trichoblasts, branched to 4 to 6 orders. Tetrasporangia are often produced as a pair per segment in the distal parts of fertile axes.

The basionym of this species is usually cited as "*Polysiphonia simpliciuscula* Crouan fr., 1867" (Ardré 1970; Saenger 1971; Abbott & Hollenberg 1976; Seagrief

1984); however, this name is predated by *Polysiphonia corallioides* Suhr ex Kützing (Kützing 1864), a taxon regarded to be a taxonomic synonym (Saenger 1971; Seagrief 1984). In their 1867 work, the Crouans referred to both their own exsiccata, "Alg. mar. Finist. 302" as well as to J. Agardh's "Sp." (1863). In reference to the Crouans' "Algues marines du Finistere," which was distributed in 1852, Dixon (1967) has made the general observation that "most of the new names are *nomina nuda*" and that by the time the Crouans published diagnoses these names had often been validated by other workers. Indeed, J. Agardh (1863) provided a description of *P. simpliciuscula*, citing "Crouan mscr." J. Agardh's account predates the description of *P. corallioides* (Kützing 1864). An inspection of the Crouans' (1852) exsiccata No. 302, however, allows us to credit it as the effective publication of their *Polysiphonia simpliciuscula* in that the section of the genus is described along with a reference to the distinctively high number of pericentral cells (20 to 26) per segment characteristic of this species. Therefore, on the basis of Article 31 of the ICBN (Greuter et al. 1988) the 1852 distribution of the Crouans' exsiccata (Sayre 1969) can be accepted as the effective and valid description of *P. simpliciuscula*. Saenger (1971) has lectotypified this species with specimen No. 302 of the Crouans' exsiccata deposited in the Laboratoire de Cryptogamie, Paris (PC). Other duplicates of this exsiccata are located at the Farlow Herbarium (FH), the University of Michigan Herbarium (MICH), the Rijksherbarium, Leiden (L), and at Berkeley, California (belonging to P. C. Silva) (Stafleu & Cowan 1976).

***Polysiphonia delicatula** Hollenberg (1968a).

Collection 3I–8 (tetrasporic).

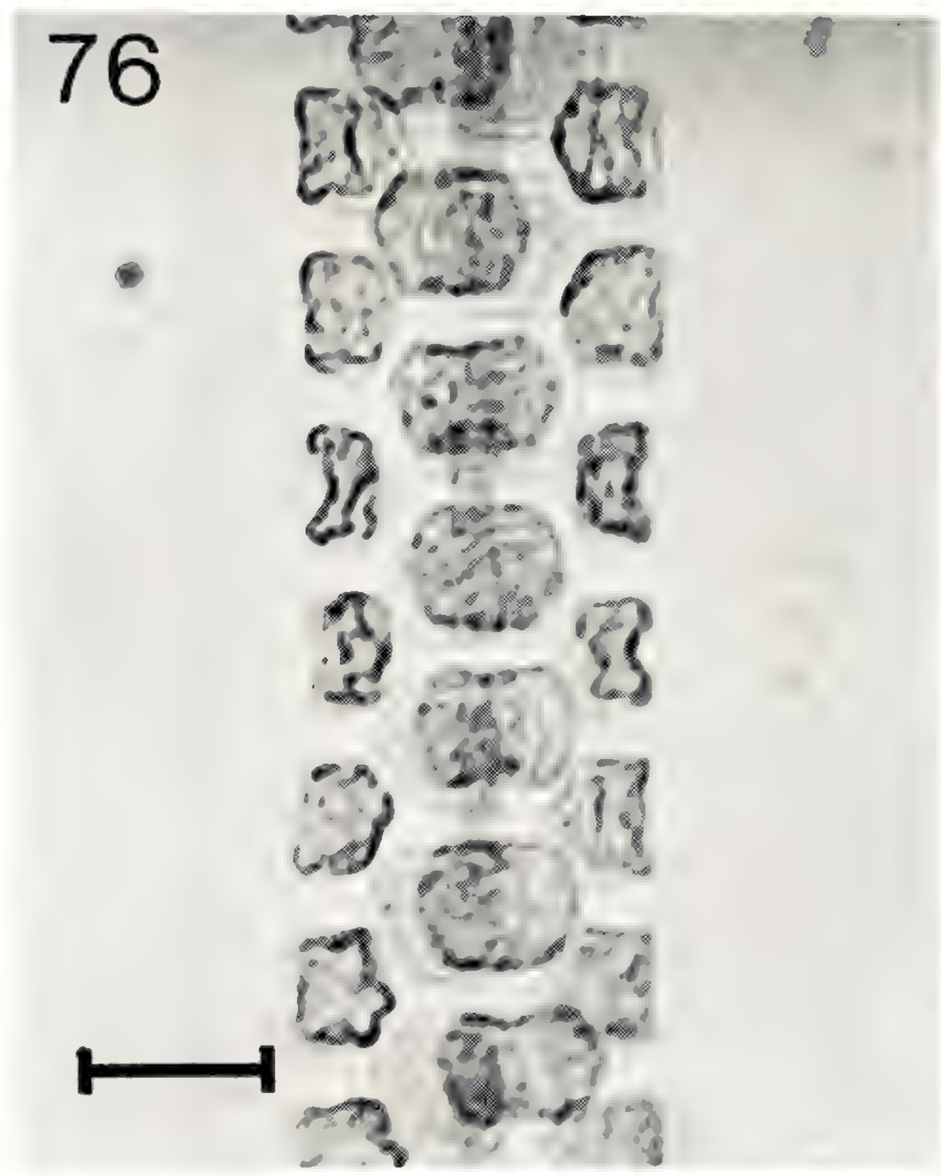
Hollenberg (1968a) described this species from Hawaii and elsewhere in the South Pacific. The Seychellois collection is also a minute epiphyte, consisting of a system of prostrate axes (50–60 µm broad) and erect axes (28–36 µm broad). Axes are tetrasiphonous and non-corticated. Trichoblasts, which are rather small, are cut off from every segment, leaving persistent scar cells on both prostrate and erect axes. Unicellular rhizoids are cut off proximally from the bearing pericentral cells. All of these features are consistent with the account given by Hollenberg (1968a) for this species. Tetrasporangia, measuring 38–44 µm in diameter, significantly distend their bearing segments.

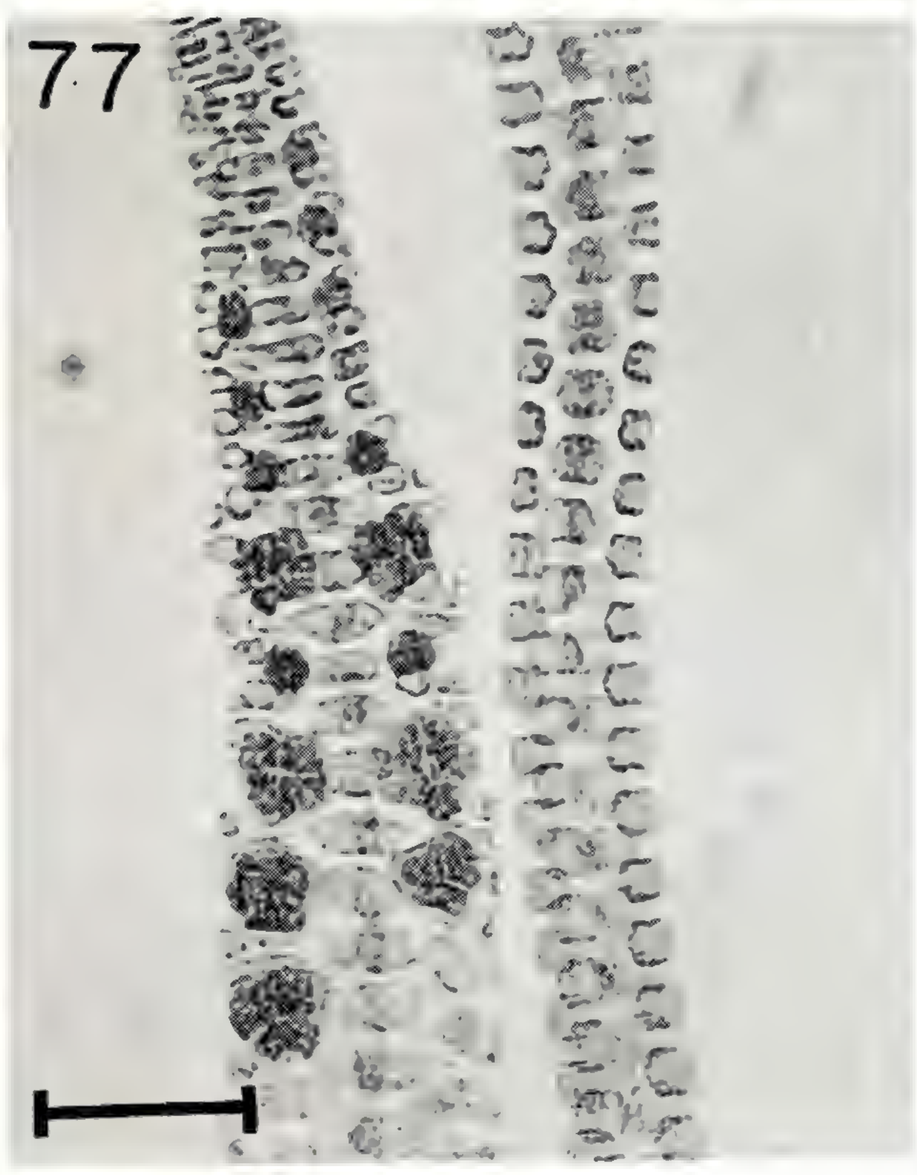
***Polysiphonia japonica** Harvey var. **savatieri** (Hariot) Yoon (1986). Figs. 74, 75.

Basionym: *Polysiphonia savatieri* Hariot (1891).

Collections: 3E–6 (male and cystocarpic; epiphytic on seagrass); 3F–3 (cystocarpic and tetrasporic; epiphytic on *Laurencia majuscula*); 3S–34 (cystocarpic and tetrasporic).

Yoon (1986) relegated *Polysiphonia savatieri* Hariot to varietal status within *P. japonica* and included within its taxonomic synonymy *P. masonii* Setchell & Gardner (1930). Earlier, Segi (1951) had placed *P. minutissima* Hollenberg (1942) and his own *P. aggregata* (Segi 1944) in synonymy with *P. savatieri*. In addition to Japan and Korea, this taxon is known (as *P. savatieri*) from the coast of California and Pacific Mexico (Abbott & Hollenberg 1976) and the Philippines (Silva et al. 1987). The distinctive combination of features of this variety includes a small thallus, ecorticate axes, trichoblasts formed at each segment, regular dichotomous branching, four pericentral cells, attachment by a dense aggregation of unicellular rhizoids, rhizoids cut off from pericentral cells, and broadly globose cystocarps




FIGS. 74–77. *Polysiphonia japonica* var. *savatieri* and *Rhodolachne decussata*. Figs. 74, 75. *P. japonica* var. *savatieri* (3E–6). Fig. 74, male thallus bearing spermatangial clusters. Fig. 75, cystocarpic thallus. Figs. 76, 77. *R. decussata* (3I–28). Fig. 76, axis with pericentral cell derivatives arranged in decussate pairs. Fig. 77, tetrasporangiate axis with two sporangia produced per segment. (Figs. 74, 75, scale bar = 100 μm; Fig. 76, scale bar = 10 μm; Fig. 77, scale bar = 30 μm.)

with a wide ostiole. Thalli reach only 0.5–1.0 cm in height, and cortication is entirely absent in var. *savatieri*, whereas thalli are much taller in var. *japonica*: to 5 cm (Segi 1951) or 20 cm (Yoon 1986), and cortication occurs in the basal portions. Yoon (1986) stated that in var. *japonica* and var. *forfex* the rhizoids are provided with terminal discoid haptera, but in var. *savatieri* the rhizoids lack discoid haptera; however, in the material here assigned to var. *savatieri* rhizoids are provided with discoid haptera at their ends.

The East African alga figured by Jaasund (1976, fig. 249) and ascribed to *Polysiphonia crassicollis* Børgesen, a species described by Børgesen (1939) from the Arabian [=Persian] Gulf, strongly resembles the Seychellois plant here identified as *P. japonica* var. *savatieri*.

***Polysiphonia sphaerocarpa** Børgesen (1918).

Collection: 3J–2A (male, cystocarpic, and tetrasporic).

This species is reported to occur commonly as an epiphyte, and our material was an epiphyte on a seagrass (*Enhalus* sp.). The thalli have a limited horizontal system attached by unicellular rhizoids cut off from sporadic pericentral cells of the creeping axes. The rhizoids are distally terminated by branched haptera. The erect branches give rise to distantly spaced lateral branches. Plants show an alternate to sub-dichotomous branching habit. There are four pericentral cells per segment, and cortication is lacking.

The type locality of this species is St. Thomas, Virgin Islands, in the Caribbean (Børgesen 1918). It is now known to have a wide distribution: various other Caribbean islands (Taylor 1960, 1969), Peru (Dawson et al. 1964), the central and western tropical Pacific (Hollenberg 1968a), North Carolina (Kapraun 1977), Colombia and Venezuela (Kapraun et al. 1983), the Salvage Islands (Weisscher 1983), the Great Barrier Reef, Australia (Cribb 1983), Korea (Yoon 1986), the Philippines (Silva et al. 1987), Corsica (Verlaque 1989), and Japan (Yoshida et al. 1990).

**Rhodolachne decussata** Wynne (1970a). Figs. 76, 77.

Collections: 3I–28 (tetrasporic); 3P–25 (cystocarpic, tetrasporic).

Previous Seychelles reports: Wynne (1970a, 1970b).

This entity was described as a new genus and species based on this Seychellois material, which comprises only tetrasporangiate specimens. Womersley and Bailey (1970) reported this alga to occur in the Solomon Islands in the southwestern Pacific and provided observations of sexual specimens. Itono (1985) described a second species, *R. radicosa*, from Fiji and southern Japan.

***Rodriguezella rhizophylla** Wynne, sp. nov.—TYPE: SEYCHELLES: Mahé Island, Anse aux Pins, growing on crustose coralline red algae, tetrasporic, 26 Oct 1964, *M. Wynne 3S–6* (holotype: MICH; isotypes: L, MICH, UC, US). Figs. 78, 81.

Alga rubra ex parte tereti basalique partem foliaceam facienti constans; thallus 25–33 mm longus; lamina 8–18 mm longa et 2.5–4.0 mm lata, margine integera vel undulata vel denticulata, cellula apicali singula exserta instructa, apice trichoblastos ferens; lamina primaria 2 series laminarum lateralium submarginalium ferens; tetrasporangia in stichidiis specialibus cylindricis portata, 700–1050 μm longitudine, 350–470 μm diametro, laminis lateralibus fortuito exorientia; sporangia matura tetraedrice divisa, 48–60 μm diametro; apex laminae primariae in organum adligans saepe mutatus, habitu decumbeenti.

FIGS. 78–80. *Rodriguezella rhizophylla, Ophidocladus simpliciusculus,* and *Tolypiocladia glomerulata.* Fig. 78. *R. rhizophylla* (3S–6), holotype. Fig. 79. *O. simpliciusculus* (3C–1), tetrasporangiate axis with two sporangia produced per segment. Fig. 80. *T. glomerulata* (3P–19), congested apical region of thallus. (Figs. 79, 80, scale bar = 100 μm.)

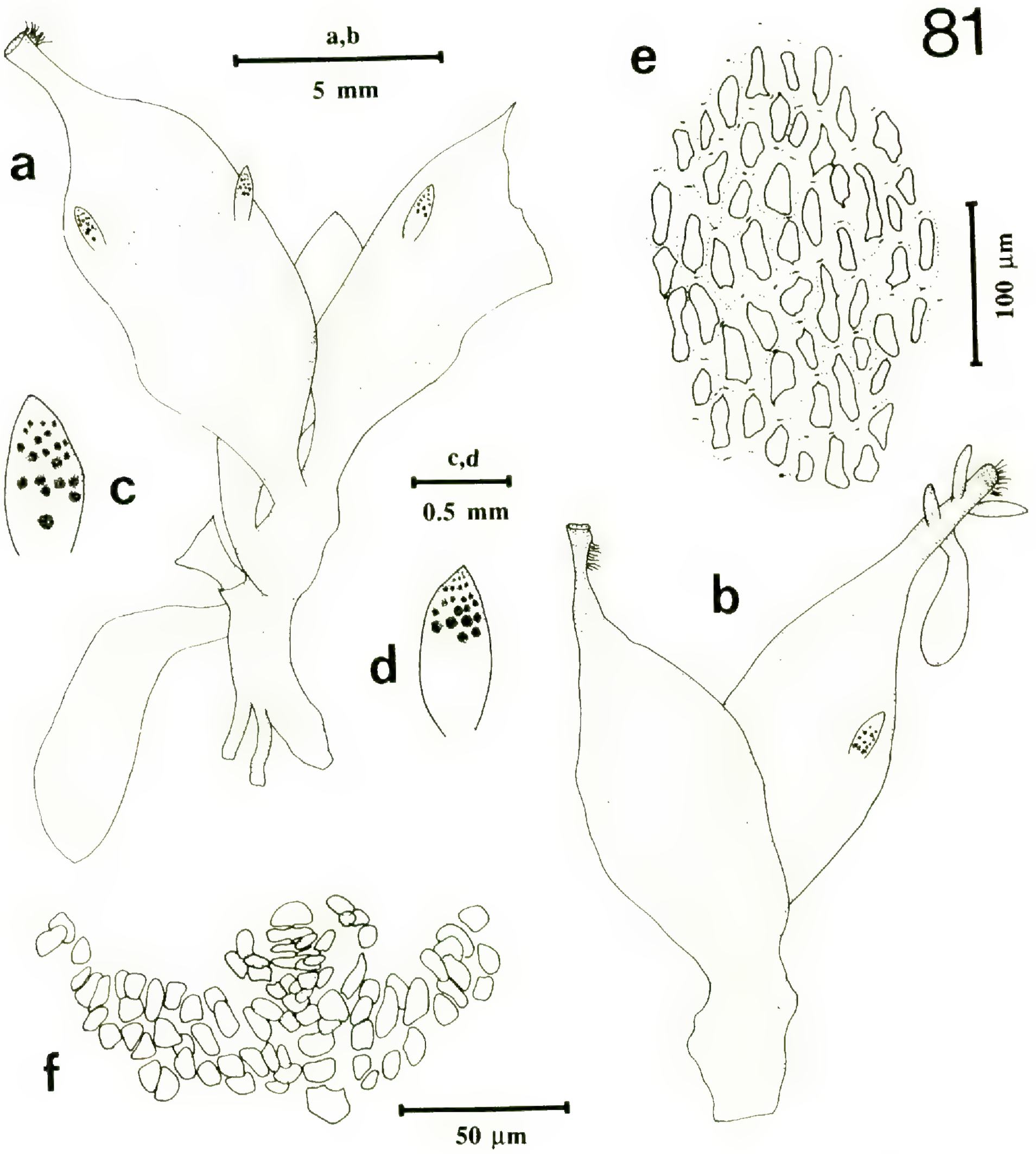



FIG. 81. *Rodriguezella rhizophylla*. a, b, tetrasporangiate specimens showing thickened basal portions, tendency of blade apices to produce rhizoids for secondary attachment, and small surface blades bearing sporangia (3I–33). c, d, detailed views of small tetrasporangiate blades (3I–33). e, surface of blades showing cortical cells connected by pit connections (3S–6). f, apex of blade with exserted apex subtended by trichoblasts (3S–6.)

Red alga consisting of a rhizomatous (presumably perennial) basal system giving rise to erect foliose blades (Figs. 81 a,b); total length of alga 25–33 mm; individual blades 8–18 mm long and 2.5–4.0 mm wide; blade margin entire to undulating, occasionally dentate; growth by means of a single apical cell, exserted, sometimes in an apical notch but still exserted (Fig. 81f); poorly developed trichoblasts sometimes associated with apex; primary blade bearing two rows of lateral blades arising submarginally; cortical cells longitudinally extended (Fig. 81e), 8–14 (–20) µm broad by (20–) 28–34 (–50) µm long; tetrasporangia borne in special cylindrical stichidia (Figs. 81c, d), 700–1050 µm long and 350–470 µm in diameter, arising at random on lateral blades; tetrasporangia tetrahedrally divided, 48–60 µm in diameter at maturity; tip of primary blade often making contact with the substratum and producing a tuft of rhizoids at this point of contact; thus the apex

is converted into an attachment organ, resulting in a decumbent habit for the plant; new blades produced at this point of attachment.

Additional collection: 3I–33 (tetrasporic).

*Rodriguezella* seems to be the most appropriate genus to assign this taxon. The genus *Rodriguezella* Schmitz (in Rodríguez 1896) differs from the related genus *Laurencia* in that in *Rodriguezella* the shoots are terete below but become flattened and leaflike above and variously lobed or divided (Kylin 1956). Additionally, growth in *Rodriguezella* is said to be sympodial unlike the monopodial growth in *Laurencia*. *Rodriguezella* has a perennial, prostrate rhizomatous system giving rise annually to well-developed foliaceous parts (Funk 1927; Feldmann 1942).

The distribution of *Rodriguezella* is centered in the Mediterranean, and the genus has a characteristic occurrence at significant depths (e.g., 70–120 m). The following species have been recognized (Ardissone 1901; Feldmann 1942; Funk 1955; Ballesteros 1990): *R. bornetii* (Rodríguez) Schmitz, which is the lectotype of the genus; *R. strafforellii* Schmitz; *R. pinnata* (Kützing) Feldmann; and *R. pennata* Ercegovic [which is not to be confused with the previous *R. pinnata*]. One taxon initially described as a *Rodriguezella*, namely *R. pelagosae* Schiffner (1931), was later transferred to *Laurencia* (Ercegovic 1949; Feldmann 1961) and subsequently was the basis of the Section *Pelagosae* within the subgenus *Laurencia* (Furnari & Serio 1993). More recently, the species was transferred to the resurrected genus *Osmundea* (Nam et al. 1994). On the other hand, the alga from Banyuls that was at first identified by Feldmann (1942) as "*R. pelagosae*" was later re-identified as *R. pinnata* (Feldmann 1961). In addition, Pham-Hoàng (1969) described *R. hongngai* from Vietnam. The name "*Rodriguezella ligulata* Feldmann," a nomen nudum, has appeared in the literature (Coppejans & Boudouresque 1983; Ben Maiz et al. 1987; Boudouresque & Perrot-Boudouresque 1987) but remains unvalidated.

Some of the Mediterranean species of *Rodriguezella* can be distinguished from *R. rhizophylla* by their greater stature: fronds 4–8 cm tall in *R. strafforellii* and 7–15 cm tall in *R. bornetii* (Rodríguez 1896). Adult plants of *R. pennata* are 6 cm tall (Ercegovic 1949). The Vietnamese *R. hongngai* was described as having thalli 1.0–1.5 cm tall with 2 mm long branches; reproductive structures were not included in the account.

Another species that bears a resemblance to *Rodriguezella rhizophylla* is *Chondria hypoglossoides*, which was described by Schmitz (1895) from Kenya and apparently has not been reported again. Schmitz had only sterile material. A slide bearing syntype material of *C. hypoglossoides* was borrowed from the The Natural History Museum, London (BM), and examined. The margins are strongly dentate (Fig. 82), much more so than in the Seychellois material being assigned to *Rodriguezella*. Yet, one point of agreement is that the lateral branches in *C. hypoglossoides* were observed to arise submarginally. There is no indication that the apex of *C. hypoglossoides* becomes attached to the substratum and forms new plants.

**Tolypiocladia glomerulata** (C. Agardh) Schmitz in Schmitz & Hauptfleisch (1897). Fig. 80.

Basionym: *Hutchinsia glomerulata* C. Agardh (1824).
Collection: 3P–19 (tetrasporic).
Previous Seychelles reports: Reinbold (1907), Kalugina-Gutnik et al. (1992).
Zhang and Xia (1979) depicted this species based on Chinese collections.

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FIG. 82. *Chondria hypoglossoides* (Type in BM.)

## PHAEOPHYTA

### ECTOCARPALES

### Ectocarpaceae

***Ectocarpus elachistaeformis** Heydrich (1892). Fig. 83.

Collection: 3I–39.

Pham-Hoàng (1969) transferred this species to *Feldmannia*, but Schneider and Searles (1991) retained it in *Ectocarpus*, because the cells contain parietal,

band-shaped, rather than discoid, chloroplasts. This species was first described from New Guinea (Heydrich 1892) and is now known from most tropical seas (Wynne 1986; Yoshida et al. 1990).

**Hincksia mitchelliae** (Harvey) Silva in Silva et al. (1987).
Basionym: *Ectocarpus mitchelliae* Harvey (1852).
Collection: 3J–2B.
Previous Seychelles report: Kalugina-Gutnik et al. (1992).

### Ralfsiaceae

***Ralfsia expansa** (J. Agardh) J. Agardh (1848).
Basionym: *Myrionema* (?) *expansum* J. Agardh (1847).
Collection: 3P–10.

This alga formed thick, brownish red, coriaceous crusts on rocks in the mid-littoral zone. Extensive sori of plurilocular sporangia were observed as well as deep hair-crypts [see Børgesen (1914) for illustrations]. Originally described from Veracruz, Mexico, this species has been reported from Indonesia (Weber-van Bosse 1913a), Tahiti (Setchell 1926), the West Indies (Børgesen 1914), North Carolina to Brazil (Earle 1969), and southern Japan (Tanaka & Chihara 1980).

## Sphacelariales

### Sphacelariaceae

***Sphacelaria novae-hollandiae** Sonder (1845).
Collections: 3C–18; 3S–31.

The present material agrees well with the various descriptions of this species (Børgesen 1941; Tsuda 1972; Lu Baoren & Tseng 1980). In *Sphacelaria novae-hollandiae* the propagules are stout and obconic and the arms of the propagules are not extended, whereas in *S. tribuloides* Meneghini the propagules are broadly triangular and with evident arms (Taylor 1960; Jaasund 1976). In Tseng (1983) the figures for these two species are reversed.

**Sphacelaria rigidula** Kützing (1843).
Collection: 3S–38.
Previous Seychelles reports: Reinbold (1907, as *S. furcigera*), Kalugina-Gutnik et al. (1992).

## Scytosiphonales

### Chnoosporaceae

**Chnoospora minima** (Hering) Papenfuss (1956).
Basionym: *Fucus minimus* Hering (1841).
Collection: 3B–1.
Previous Seychelles report: Kalugina-Gutnik et al. (1992).

This alga occurs on surf-buffeted boulders in the littoral zone, accompanied by other surf-tolerant species, *Dermonema frappieri* and *Chaetomorpha antennina*. This species, reported earlier from the Seychelles by Kalugina-Gutnik et al. (1992),

has a widespread tropical distribution, including the Caribbean (Taylor 1942), West Africa (Lawson & John 1987), South Africa (Seagrief 1984), Hawaii (Magruder & Hunt 1979), the Philippines (Silva et al. 1987), Japan (Yoshida et al. 1990), and China (Tseng 1983). It has also been reported to be an apparent adventive to northern New Zealand (Nelson & Duffy 1991).

### Scytosiphonaceae

**Colpomenia sinuosa** (Roth) Derbès & Solier in Castagne (1851).
Basionym: *Ulva sinuosa* Roth (1806).
Collection: 3C–5.
Previous Seychelles reports: Mshigeni (1987a), Untawale and Jagtap (1989), and Kalugina-Gutnik et al. (1992).

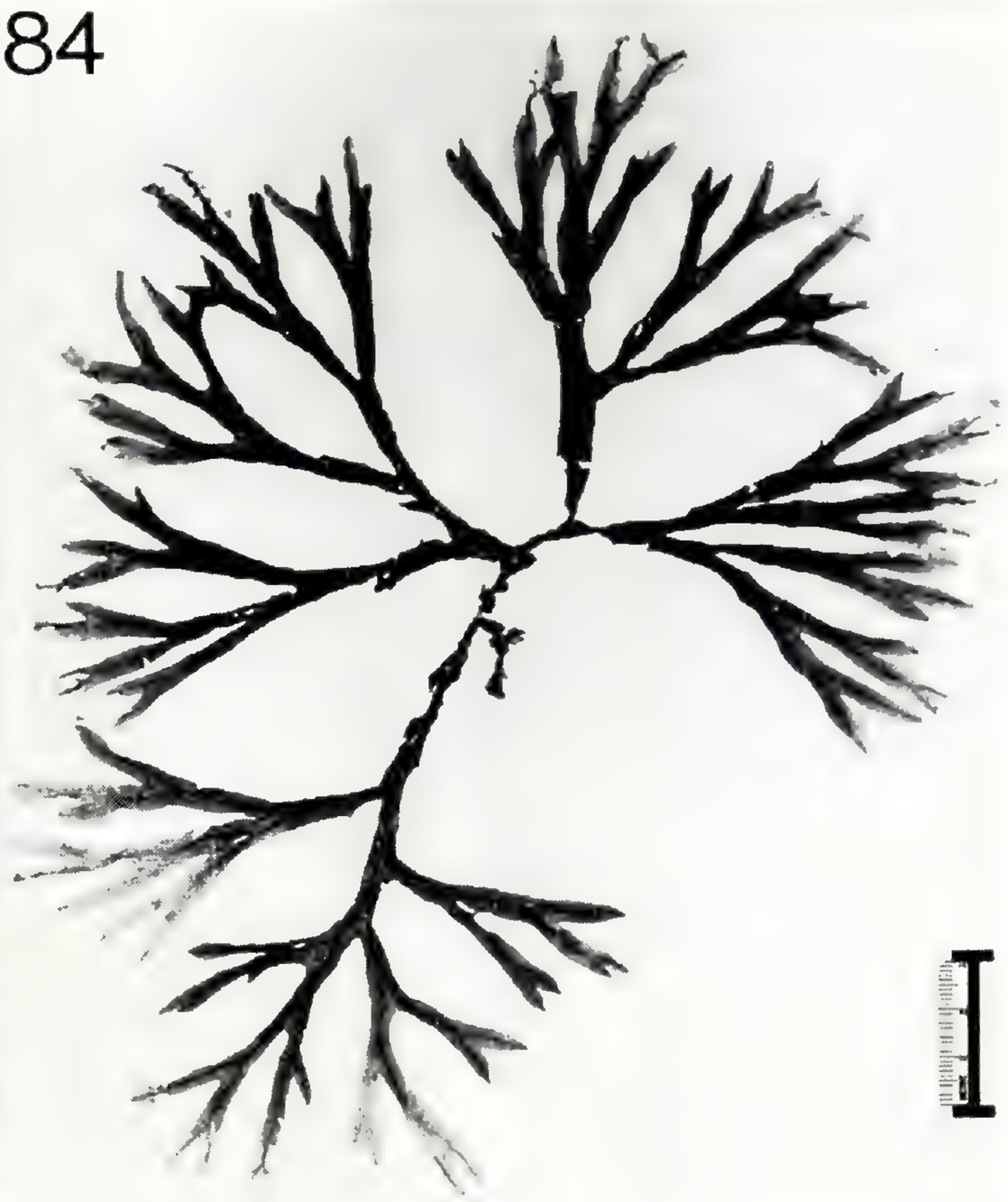
## Dictyotales

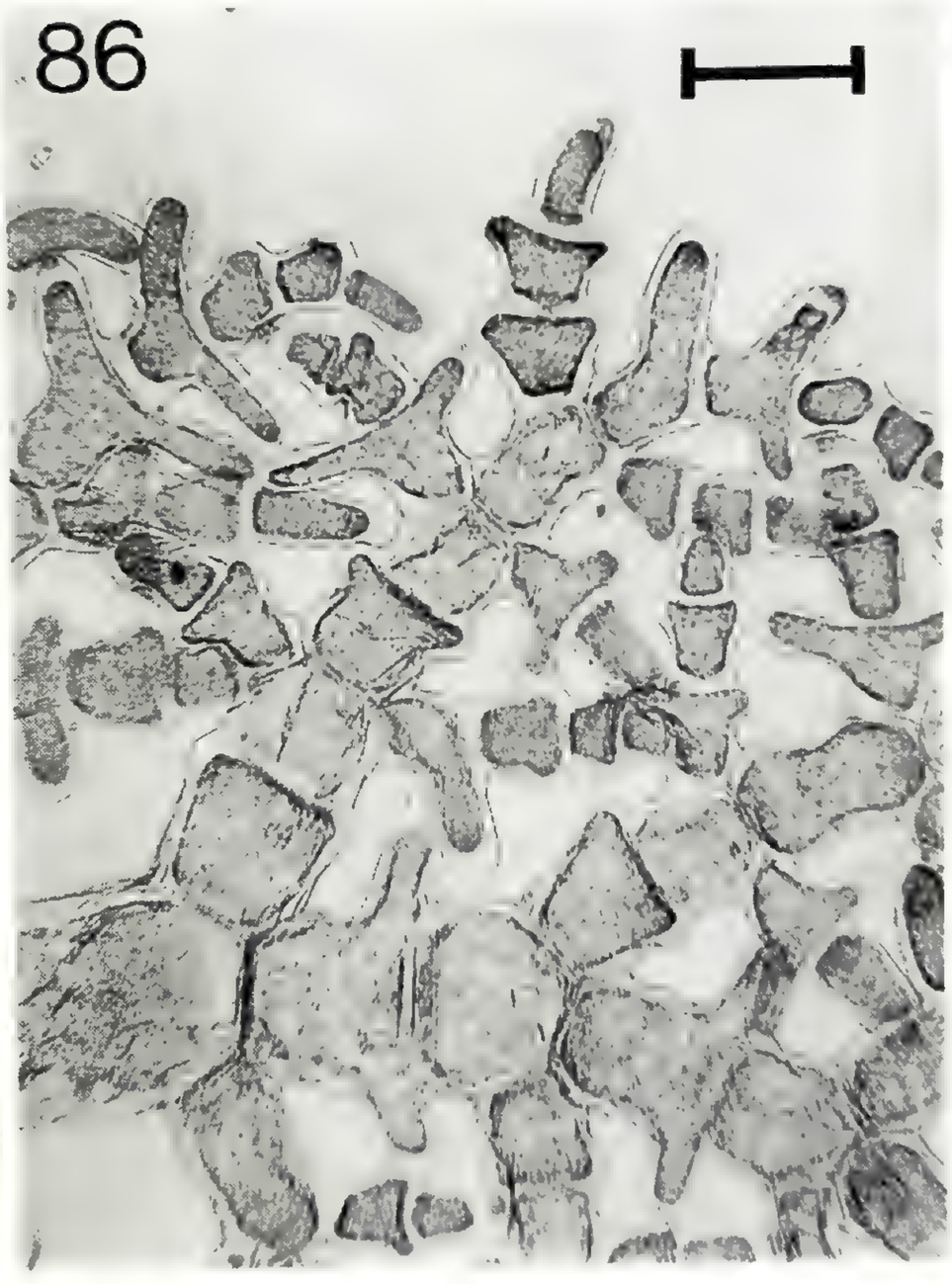
### Dictyotaceae

**Dictyopteris delicatula** Lamouroux (1809b).
Collection: 3P–5.
Previous Seychelles reports: Mshigeni (1987a), Kalugina-Gutnik et al. (1992).

***Dictyopteris woodwardia** (Brown ex Turner) Schmidt (1938). Fig. 84.
Basionym: *Fucus woodwardia* Brown ex Turner (1811).
Collection: 3O–1.
The margins of the blades in this species bear minute teeth, separating this species from *Dictyopteris plagiogramma* (Montagne) Vickers and *D. polypodioides* (de Candolle) Lamouroux, two species with entire margins, which were reported from the Seychelles (Untawale & Jagtap 1989; Kalugina-Gutnik et al. 1992). *Dictyopteris woodwardia* was first described by Turner (1811) from the north coast of Australia. Its range includes northern and eastern Australia (Lewis 1985) and also India (Børgesen 1937b) and Sri-Lanka (Durairatnam 1961). It is to be noted that "woodwardia" rather than "woodwardii" is the correct epithet. Turner (1811) explicitly employed the former to commemmorate both T. J. Woodward and the fern genus, which this brown alga resembles.

**Dictyota bartayresiana** Lamouroux (1809a).
Collection: 3S–16.
Previous Seychelles reports: Untawale and Jagtap (1989, as *D. bartayresia*), Kalugina-Gutnik et al. (1992, as *D. bartayresii*).
Jaasund (1970c) was the first to attempt a clarification of the confusion over the identity of *Dictyota bartayresiana*. Two concepts of the species had developed. Jaasund's view was that plants with acute tips conformed to Lamouroux's original description and also to Harvey's (1852) and Vickers's (1908) sense of the species. Plants with rounded thallus ends and also called *D. bartayresiana* by Kützing (1859), Taylor (1960), and Schnetter (1976) were excluded but later described as a new species, *D. neglecta*, by Hörnig et al. (1992a).
The Seychellois plants have the acute tips and the dotted appearance typical of the species (Jaasund 1970c). Sporangia are scattered and involucrate. Thallus widths are 3–4 mm. Although the branching in this species is usually described as






FIGS. 83–86. *Ectocarpus elachistaeformis*, *Dictyopteris woodwardia*, *Caulerpa ambigua*, and *Struvea anastomosans*. Fig. 83. *E. elachistaeformis* (3I–39), thallus with plurilocular sporangia (*arrows*). Fig. 84. *D. woodwardia* (3O–1), herbarium specimen. Fig. 85. *C. ambigua* (3I–12), thalli. Fig. 86. *S. anastomosans* (3S–30), anastomosing branches of thallus. (Figs. 83, 85, 86, scale bar = 100 μm; Fig. 84 scale bar = 3 cm.)

"always dichotomous" (Lawson & John 1982), some of the Seychellois material showed sub-dichotomous branching similar to that shown for this species by Vickers (1908, pls. XII, XIII) but not the distinctly alternately branched pattern of *D. mertensii* (Martius) Kützing.

**Dictyota cervicornis** Kützing (1859).

Collection: 3D–14.

Previous Seychelles report: Mshigeni (1987a), Kalugina-Gutnik et al. (1992, as *D. indica*).

Plants reach 20 cm in height, are subdichotomously branched to several orders, and often have cervicorn thallus ends, in agreement with Hörnig et al.'s (1992b) account of *Dictyota cervicornis*. Blade widths are about 2 mm wide, and internodes are 10–20 mm long. Small proliferations arising from the blade surface are present.

Hörnig et al. (1992a) regarded *Dictyota cervicornis*, *D. pardalis* Kützing, and *D. indica* Sonder ex Kützing to be conspecific. The three names were published simultaneously (Kützing 1859). Hörnig et al. (1992) selected *D. cervicornis* because it has been most widely used. Other species of *Dictyota* reported from the Seychelles by Kalugina-Gutnik et al. (1992) are *D. ceylanica* Kützing, *D. divaricata* Lamouroux, *D. friabilis* Setchell, *D. patens* J. Agardh, and a *Dictyota* sp. Hörnig and Schnetter (1988) treated *D. divaricata* within the taxonomic synonymy of *D. dichotoma* (Hudson) Lamouroux var. *intricata* (C. Agardh) Greville.

**Dictyota dichotoma** (Hudson) Lamouroux (1809).

Basionym: *Ulva dichotoma* Hudson (1762).

Collections: 3C–13; 3O–5.

Previous report: Untawale and Jagtap (1989).

These collections are assigned to this species with some reservation because the plants are sterile. Yet, the vegetative features ally them with *Dictyota dichotoma*, a species with an allegedly wide distribution in temperate and tropical seas (Schnetter et al. 1987; Womersley 1987). The plants are erect, reaching 6–7 cm in height and with blades 3–5 mm in width. Axes are evenly dichotomous branched, and blade margins are entire. Schnetter et al. (1987) segregated the tropical western Atlantic entity that had been called *D. dichotoma* as *D. menstrualis* (Hoyt) Schnetter, Hörnig & Weber-Peukert.

**Dictyota friabilis** Setchell (1926).

Collection: 3D–8.

Previous Seychelles report: Kalugina-Gutnik et al. (1992).

The most distinctive feature of *Dictyota friabilis* is the strong tendency of the blades to become mutually connate by the production of thick rhizoidal outgrowths. Tanaka and Chihara (1988) described plants of this species as overlapping one another. The habit is largely prostrate, and the clump-forming plants were attached to small rocks mixed with sand. The plants have a fragile texture, and it is difficult to tease them out to make herbarium specimens, as commented on both by Setchell (1926) and Jaasund (1970c). Blades are 2.5–4.5 mm wide and are fairly crisp, up to 250 μm thick in the basal portions. Sporangia are scattered and involucrate, as depicted by Jaasund (1970c).

**Dictyota** sp.

Collection: 3S–7.

**Lobophora variegata** (Lamouroux) Womersley (1967).
Basionym: *Dictyota variegata* Lamouroux (1809a).
Collections: 3C–1A; 3G–1; 3I–5 (epiphytic); 3P–24.
Previous Seychelles reports: Mshigeni (1987a, as *Pocockiella variegata*), Untawale and Jagtap (1989), Kalugina-Gutnik et al. (1992).

### Fucales

#### Sargassaceae

**Sargassum** spp.
Numerous specimens of *Sargassum* were collected but not yet identified.

**Turbinaria decurrens** Bory (1828).
Collections: 3N–1; 3P–29.
Previous Seychelles reports: Untawale and Jagtap (1989), Kalugina-Gutnik et al. (1992).
These two collections were identified with the key in Taylor (1963). Collection 3N–1 occurred in abundance among smooth coral heads.

## CHLOROPHYTA

### Ulvales

#### Ulvaceae

**Enteromorpha clathrata** (Roth) Greville (1830).
Basionym: *Conferva clathrata* Roth (1806).
Collection: 3I–47.
Previous Seychelles report: Kalugina-Gutnik et al. (1992).
This species occurred as a small epiphyte on seagrass blades. Only the basal portions were not uniseriate. This material is similar to Bliding's (1963) Type II of this species.

**Ulva rigida** C. Agardh (1822).
Collection: 3S–11.
Previous Seychelles report: Kalugina-Gutnik et al. (1992).
These plants were very small (to 10 mm tall) and are assigned to this species primarily on the basis of their rosette-formation (Jaasund 1976). Blades are 40–44 μm in thickness in mid-region, which is less than the range of 60–110 μm given by Krishnamurthy and Joshi (1969).

### Cladophorales

#### Cladophoraceae

**Chaetomorpha crassa** (C. Agardh) Kützing (1845).
Basionym: *Conferva crassa* C. Agardh (1824).
Collection: 3D–7.
Previous Seychelles report: Kalugina-Gutnik et al. (1992).

This alga formed an entangled mass intermixed with *Chaetomoprha ligustica* (see below). Cell widths are 300–435 µm; cell lengths are 265–800 µm. Although cell walls are thick, the filaments are characteristically softer than the filaments of *C. linum* (O. F. Müller) Kützing (Taylor 1960). This species is widely distributed, especially in warm waters (Krishnamurthy & Joshi 1970; Jaasund 1976; Silva et al. 1987).

**Chaetomorpha ligustica** (Kützing) Kützing (1849).

Basionym: *Conferva ligustica* Kützing (1845).

Collection: 3D–7A.

Previous Seychelles report: Kalugina-Gutnik et al. (1992).

Silva et al. (1987) offered this binomial as the correct name for the alga that has been incorrectly called "*Chaetomorpha tortuosa*" and also *C. capillaris* (Kützing) Børgesen. These names have been applied to an alga based on a Mediterranean type. Cell widths for the Seychellois material measure 78-110 µm; cell lengths measure 172–360 µm. These measurements conform to those given by Womersley (1984, as *C. capillaris*). The collection formed a floating entangled mass, intertwined with *Chaetomorpha crassa*.

**Cladophora vagabunda** (Linnaeus) van den Hoek (1963).

Basionym: *Conferva vagabunda* Linnaeus (1753).

Collection: 3S–35.

Previous Seychelles reports: Untawale and Jagtap (1989, as *C. fascicularis*), Kalugina-Gutnik et al. (1992).

This species was represented by several small specimens epiphytic on *Gelidiopsis repens* and *Dictyota pinnatifida*. The habit is a densely branching tuft attached by a system of irregularly branching rhizoids. The cells and the branchlets are arching as depicted by Jaasund (1976, as *C. mauritiana*). The proposal by van den Hoek (1982) to include *C. fascicularis* (C. Agardh) Kützing and *C. mauritiana* Kützing in *C. vagabunda* is followed here.

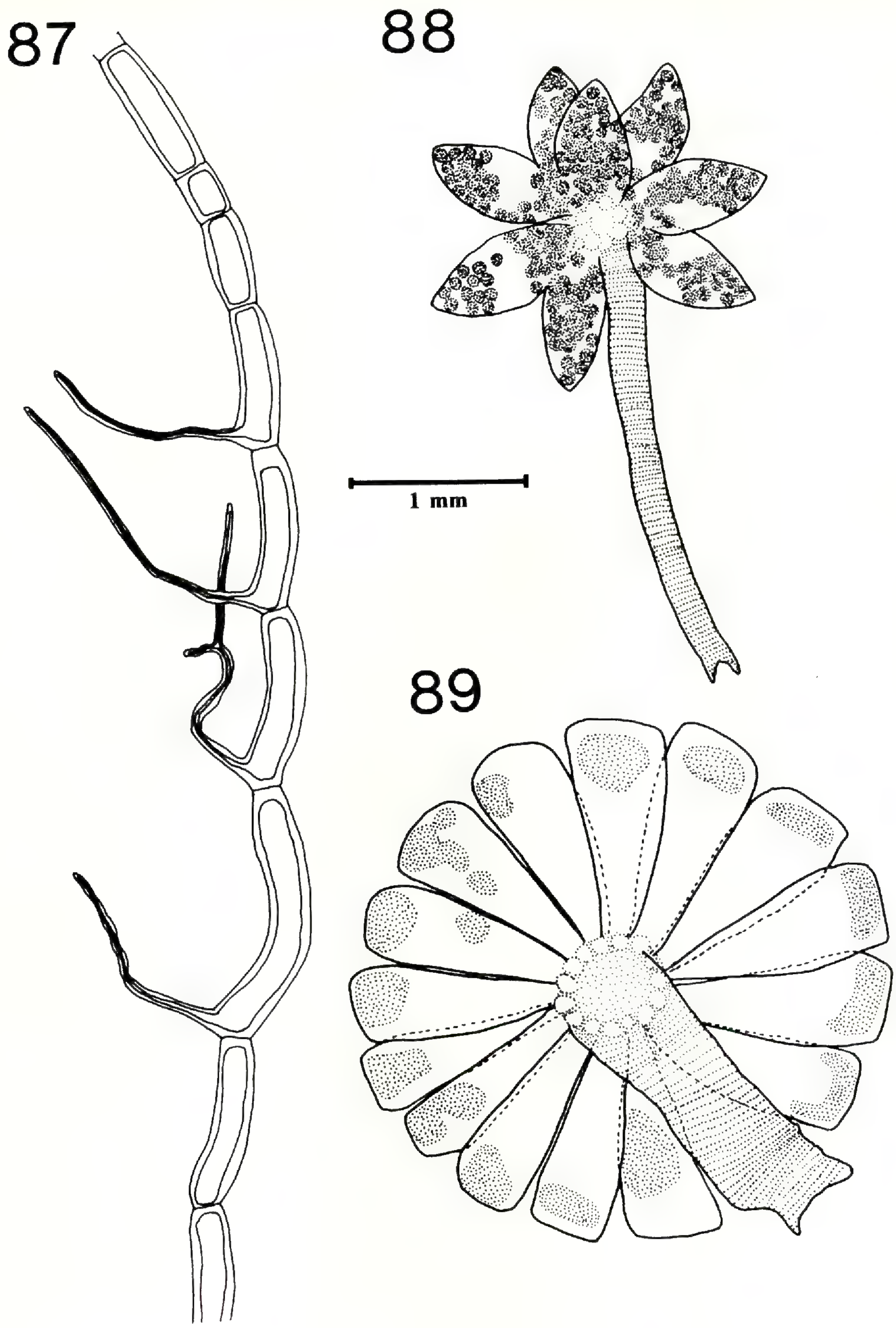
Gilbert (1965, as *C. fascicularis*) stated that this species is relatively common in Hawaii, where it is found attached or free-floating. Egerod (1974, as *C. fascicularis*) reported this species from Thailand.

*__Rhizoclonium grande__ Børgesen (1935). Fig. 87.

Collection: 3C–3.

*Rhizoclonium grande* is distinctive because of the large size of the cells and the production of numerous rhizoids, which are in cytoplasmic continuity with the bearing cell. Cells are 240–280 µm broad in comparison with ranges of 275–400 µm reported by Børgesen (1935) and 225–400 µm reported by Gilbert (1965). Walls are thick and stratified. The Seychellois plants were growing attached to sand grains at a depth of 2 meters. *Rhizoclonium grande* has been reported from Mauritius (Børgesen 1952), Hawaii (Gilbert 1965), Thailand (Egerod 1975), Tanzania (Jaasund 1976), and the Philippines (Fortes & Trono 1980). A closely related if not identical species is *R. robustum* described by Setchell and Gardner (1937) from the Galapagos Islands.

According to Dixit (1968), *Chaetomorpha prostrata* Anand (1940), described from Karachi, Pakistan, is the same as *Rhizoclonium grande*. Dixit also expressed the opinion that this alga may merely represent the basal perennial portion of *Cladophoropsis zollingeri* (Kützing) Reinbold. Careful field or culture studies are needed to determine whether this is true.




FIGS. 87–89. *Rhizoclonium grande, Polyphysa exigua,* and *P. parvula.* Fig. 87. *R. grande* (3C–3), filament bearing rhizoids. Fig. 88. *P. exigua* (3C–20), mature plant bearing cysts. Fig. 89. *P. parvula* (3C–19), sterile plant.

## Caulerpales

### Bryopsidaceae

*__Bryopsis indica__ Gepp & Gepp (1908).

Collection: 3P–16.

A double row of pinnae on either side of the axis appears to be present, a feature that distinguishes this species (Dawson 1956).

### Codiaceae

*__Codium dwarkense__ Børgesen (1946).

Collection: 3T–1.

Dr. P. C. Silva kindly provided this determination of this dichotomously branched *Codium* first described from India. It did not appear in the list of Seychellois algae by Kalugina-Gutnik et al. (1992), although they did report *C. formosanum* Yamada, *C. geppii* O. C. Schmidt, *C. tomentosum* (Hudson) Stackhouse, and a *Codium* sp.

### Caulerpaceae

**Caulerpa racemosa** (Forsskål) J. Agardh (1873) var. **racemosa**.

Basionym: *Fucus racemosus* Forsskål (1775).

Collection: 3D–3.

Previous Seychelles reports: Mshigeni (1987a), Kalugina-Gutnik et al. (1992).

The nominate variety of this quite variable species is here regarded as characterized by the crowded, imbricate nature of the branchlets and their distally swollen shape. This morphology conforms to Taylor's (1960) characterization of *C. racemosa* var. *uvifera* (C. Agardh) Weber-van Bosse (1898), which is treated as a taxonomic synonym in agreement with Papenfuss and Egerod (1957).

**Caulerpa racemosa** (Forsskål) J. Agardh var. **peltata** (Lamouroux) Eubank (1946).

Basionym: *Caulerpa peltata* Lamouroux (1809b).

Collections: 3D–17; 3I–49; 3P–4.

Previous Seychelles reports: Mshigeni (1987a, as *C. peltata*), Kalugina-Gutnik et al. (1992).

Although some authors still prefer to maintain var. *peltata* as a species distinct from *C. racemosa*, Ohba and Enomoto (1987) have presented experimental evidence obtained from various culturing conditions that var. *peltata* and var. *laetevirens* are morphological variations of a single species. Their work thus supports the taxonomic opinion of Eubank (1946) to recognize *C. peltata* Lamouroux at the varietal level within *C. racemosa*. In the older literature Weber-van Bosse (1898), Svedelius (1906), and Børgesen (1925) have reported their observations on transitional forms between *C. racemosa* and *C. peltata*.

**Caulerpa serrulata** (Forsskål) J. Agardh (1837).

Basionym: *Fucus serrulata* Forsskål (1775).

Collection: 3D–4.

Previous Seychelles reports: Mshigeni (1987a), Untawale and Jagtap (1989), Kalugina-Gutnik et al. (1992).

This alga was growing intermingled with *Caulerpa racemosa* but in much less abundance.

*__Caulerpella ambigua__ (Okamura) Prud'homme van Reine & Lokhorst (1992). Fig. 85.

Basionym: *Caulerpa ambigua* Okamura (1897).

Collections: 3D–13; 3G–15; 3I–12 (epiphytic on crustose coralline algae); 3P–3.

Eubank (1946) presented evidence that *Caulerpa vickersiae* Børgesen (1911) is conspecific with *C. ambigua* Okamura (1897). Subsequently, she withdrew her recognition of varieties within *C. ambigua* (Egerod 1952). Recently, Prud'homme van Reine and Lokhorst (1992) segregated *C. ambigua* into its own genus on the basis of its non-holocarpic reproduction. They observed the presence of compound zoidangia (possibly gametangia) clustered around a central discharge tube. These zoidangia had been interpreted by earlier workers (Taylor 1967; Kemperman & Stegenga 1983) as starch-filled storage organs.

## Udoteaceae

**Chlorodesmis fastigiata** (C. Agardh) Ducker (1969).

Basionym: *Vaucheria fastigiata* C. Agardh (1824).

Collections: 3C–4; 3D–9.

Previous Seychelles report: Ducker (1967, as *C. comosa*), Kalugina-Gutnik et al. (1992, as *C. comosa*).

This collection was included in Ducker's (1967) monograph as *Chlorodesmis comosa* Harvey & Bailey, a taxon which was later shown by Ducker (1969) to be conspecific with *C. fastigiata*. A second species, *C. hildebrandtii* A. Gepp & E. S. Gepp, was reported by Mshigeni (1987a) and Untawale and Jagtap (1989).

**Halimeda macroloba** Decaisne (1841).

Collection: 3H–1.

Previous Seychelles records: Hillis (1959), Segonzac (1984), Mshigeni (1987a), Kalugina-Gutnik et al. (1992).

A single specimen was collected growing in sandy substratum at a depth of 3 m. The geographic distribution of this species, originally described from the Red Sea, includes the western and eastern Indian Ocean and the western Pacific, both north and south (Hillis-Colinvaux 1980).

**Halimeda opuntia** (Linnaeus) Lamouroux (1816) var. **opuntia.**

Basionym: *Corallina opuntia* Linnaeus (1758).

Collections: 3I–11; 3J–4; 3S–19.

Previously Seychelles reports: Mshigeni (1987a), Untawale and Jagtap (1989), Kalugina-Gutnik et al. (1992), Titlyanova et al. (1992).

In addition to *H. macroloba* and *H. opuntia*, several other species of this genus are now known to occur in this island group: *H. copiosa* Goreau & Graham, *H. gracilis* Harvey ex J. Agardh, *H. incrassata* (Ellis) Lamouroux, *H. micronesica* Yamada, *H. stuposa* W. R. Taylor, and *H. tuna* (Ellis & Solander) Lamouroux (Hillis 1959; Segonzac 1984; Untawale & Jagtap 1989; Kalugina-Gutnik et al. 1992).

*__Pseudochlorodesmis furcellata__ (Zanardini) Børgesen (1925).

Basionym: *Bryopsis furcellata* Zanardini (1863).

Collection: 3I–35.

These inconspicuous plants consist of a tuft of non-calcified, irregularly branched, siphonous filaments lacking constrictions. The erect filaments are 34–42

μm broad and reach a height of less than 1 cm; they are attached to the substrate by a network of rhizoidal filaments. This species was originally known from the Mediterranean (Zanardini 1863; Feldmann 1937) and the Canary Islands (Børgesen 1925), but its range is now known to include various places in the tropical Pacific Ocean: Vietnam (Dawson 1954), Enewetak, Marshall Islands (Gilmartin 1960), and Hawaii (Gilbert 1962). According to Meinesz (1980), Gilbert's (1962) *Udotea? abbreviata* conforms to typical *Pseudochlorodesmis furcellata*, and Gilbert's *P. parva* is identical to *P. furcellata* var. *canariensis* Børgesen, which differs from the nominate variety by its smaller overall dimensions and reduced branching habit.

## Siphonocladales

### Siphonocladaceae

**Boodlea composita** (Harvey) Brand (1904).

Basionym: *Conferva composita* Harvey (1834).

Collections: 3P–39; 3S–15.

Previous Seychelles report: Kalugina-Gutnik et al. (1992).

Spongiose cushions made up of branching filaments are formed in this species. Branching may be alternate, pinnate, or irregular, the branches anastomosing with one another by means of small hapteroid segments (Børgesen 1940; Egerod 1952; Trono & Ganzon-Fortes 1980). Kalugina-Gutnik et al. (1992) also reported *Boodlea siamensis* Reinbold, *B. struveoides* Howe, and a "*Boodlea* sp."

*__Cladophoropsis zollingeri__ (Kützing) Reinbold (1905).

Basionym: *Cladophora zollingeri* Kützing (1849).

Collection: 3G–6.

Filaments measures 250–295 μm broad. Egerod (1971) noted that some 26 names of *Cladophoropsis* are in current use and that the genus is in need of revision. Cribb (1960) regarded *C. zollingeri* as doubtfully distinct from *C. herpestica* (Montagne) Howe, but *C. zollingeri* has been maintained by Womersley and Bailey (1970) and Silva et al. (1987). Egerod (1975) reported *C. sundanensis* Reinbold to have finer filaments, reaching a diameter of up to 180 μm. Kalugina-Gutnik et al. (1992) recorded the occurrence of *C. herpestica*, *C. membranacea* (C. Agardh) Børgesen, *C. modonensis* (Kützing) Børgesen, and *C. sundanensis*.

**Dictyosphaeria versluysii** Weber-van Bosse (1905).

Collections: 3G–5; 3S–12.

Previous Seychelles report: Kalugina-Gutnik et al. (1992).

The more commonly observed species, *Dictyosphaeria cavernosa* (Forrskål) Børgesen, was also reported by Untawale and Jagtap (1989) and Kalugina-Gutnik et al. (1992).

**Struvea anastomosans** (Harvey) Piccone & Grunow ex Piccone (1884). Fig. 86.

Basionym: *Cladophora ? anastomosans* Harvey (1859).

Collections: 3G–4; 3I–7; 3S–30.

Previous Seychelles report: Kalugina-Gutnik et al. (1992).

Besides this species Kalugina-Gutnik et al. (1992) also listed *Struvea elegans* Børgesen and a "*Struvea* sp. 1" and a "*Struvea* sp. 2."

**Ventricaria ventricosa** (J. Agardh) Olsen & J. West (1988).

Basionym: *Valonia ventricosa* J. Agardh (1887).

Collection: 3S–17.

Previous Seychelles reports: Untawale and Jagtap (1989, as *Valonia ventricosa*), Kalugina-Gutnik et al. (1992).

Olsen and West (1988) presented evidence for segregating this species into its own genus, which they tentatively placed in the Siphonocladaceae because of similarities to *Siphonocladus* and *Dictyosphaeria*.

## Valoniaceae

**Valonia utricularis** (Roth) C. Agardh (1822).

Basionym: *Conferva utricularis* Roth (1797).

Collection: 3S–41.

Previous Seychelles report: Kalugina-Gutnik et al. (1992).

A single small thallus was noted growing on coral; it had the small dimensions and the repent habit characteristic of *Valonia utricularis*, as reported by Taylor (1960). Kalugina-Gutnik et al. (1992) also reported the occurrence of *V. aegragropila* C. Agardh and *V. fastigiata* Harvey ex J. Agardh.

## Dasycladales

## Polyphysaceae

**Polyphysa exigua** (Solms-Laubach) Wynne, comb. nov. *Acetabularia exigua* Solms-Laubach, Trans. Linn. Soc. London, Bot. 5: 28, pl. 2, figs 1, 4, 1895. Fig. 88.

Collection: 3C–20.

Previous Seychelles reports: Kalugina-Gutnik et al. (1992, as *Acetabularia exigua*), Titlyanova (1992, as *A. exigua*).

In his monograph of *Acetabularia*, Solms-Laubach (1895) recognized *Polyphysa* Lamarck (1816), characterized by the absence of an inferior corona, as a section within *Acetabularia*. *Polyphysa* was re-established as a genus by Bailey et al. (1976), and several workers (e.g., Schnetter & Bula Meyer 1982; Womersley 1984; Sosa 1985) have followed their opinion. Since an inferior corona is absent in thalli of *A. exigua* (Valet 1969; Egerod 1975; Moorjani 1980), this species should also be transferred to *Polyphysa*, and this change is effected above. Berger and Kaever (1992) also called this alga *P. exigua* but did not validate this binomial according to Art. 33.2 of the Code (Greuter et al. 1988).

**Polyphysa parvula** (Solms-Laubach) Schnetter & Bula-Meyer (1982). Fig. 89.

Basionym: *Acetabularia parvula* Solms-Laubach (1895).

Collections: 3C–19; 3S–25.

Previous Seychelles report: Kalugina-Gutnik et al. (1992, as *Acetabularia parvula*); Titlyanova (1992, as *A. parvula*).

The lack of an inferior corona led Schnetter and Bula Meyer (1982) to transfer this species to *Polyphysa*. Valet (1969) presented evidence that *Acetabularia parvula* and *A. moebii*, both species described by Solms-Laubach in 1895, were conspecific. Valet also included *A. minutissima* Okamura (1912) and *A. wettsteinii*

Schussnig (1930) as taxonomic synonyms. This taxonomic opinion was supported by Dong and Tseng (1985). Berger and Kaever (1992) grew the three species (*A. parvula*, *A. moebii*, and *A. wettsteinii*) in culture and showed that crosses between the three cultures confirmed their identity. *Acetabularia velasquezii* Trono et al. (1978) was also regarded as a taxonomic synonym (Berger & Kaever 1992).

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# APPENDIX

## Collection Sites in the Seychelles

3A: [a freshwater collection not included in this report]
3B: Anse Grande, Mahé Island; 15.x.1964; boulders exposed to heavy surf.
3C: Anse Royal, Mahé Island; 15.x.1964; coral reef area and sandy area protected by reef.
3D: west shore of Ste. Anne Island, approx. 2 miles east of Port Victoria, Mahé Island; 16.x.1964.
3E: in drift off Moyenne Island, east of Port Victoria, Mahé Island; 16.x.1964.
3F: north shore of Cerf Island 3 m depth among coral heads; 17.x.1964.
3G: east shore of Mahé Island, outer face of coral reef 0.5 mile northeast of Cascade Church; 18.x.1964.
3H: Ste. Anne Island, 19.x.1964; sandy substrate.
3I: Anse aux Pins, Mahé Island; 19.x.1964; coral reef area.
3J: seagrass flat (including *Enhalus*), south of Victoria, Mahé Island; 20.x.1964.
3K: in drift on east side of Anonyne I.; 20.x.1964.
3L: sand flats next to Victoria pier, Mahé Island; 20.x.1964.
3M: coral reef in Victoria harbor, Mahé Island, north of Cerf Island; 21.x.1964.
3N: same site as 3M; 22.x.1964.
3O: Praslin Island; 23.x.1964.
3P: northeast point of Mahé Island; 25.x.1964; shallow-water collections.
3Q: off northeast point of Mahé Island; 25.x.1964; 15-m depth.
3R: Port Victoria, Mahé Island; 26.x.1964.
3S: Anse aux Pins, Mahé Island; 26.x.1964; coral reef area.
3T: Beau Vallon, Belle Ombre, west side of Mahé Island; 26.x.1964; coral reef area.
3U: coral reef between Cerf Island and Ste. Anne Island; 27.x.1964.